Using Excel to Graph Eggtimer Flight Data

Microsoft Excel is a very useful tool, because it not only offers the ability to take formatted data and mathematically manipulate it, but it also has some decent graphing capabilities too. This tutorial will show you how to download flight data from the Eggtimer and create data graphs using Excel. This document was created using Excel 2003, but it's the same with just about every version since then.

Downloading the Eggtimer Flight Data

The Eggtimer downloads two kinds of data, a text-formatted flight/settings summary and a .csv-formatted flight detail. We're going to concentrate on the flight detail. Connect your USB-Serial cable to your PC, startup your terminal emulator program, and power on your Eggtimer. When it starts beeping, hit the "?" key to enter the Flight Display screen:

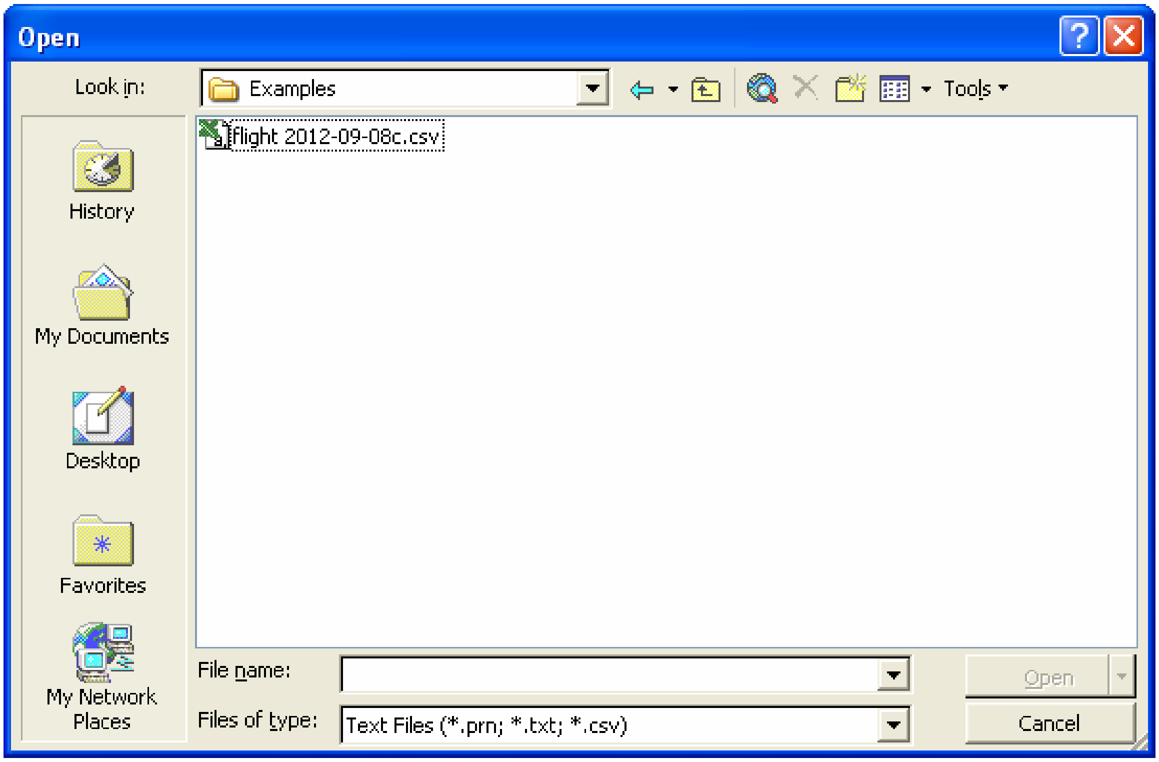
```
Eggtimer Build-1.35     Saved Flight Summary

    Page      Apogee    Max Veloc.
A   0         1069      298            BMP flight 2012-09-08c
B   15        0         0              BMP flight 2012-09-08a
C   14        1286      3773           BMP flight 2012-09-08a
D   13        1358      322            BMP flight 2012-09-08a
E   12        2283      3339           BMP flight 2012-09-08a
F   11        2135      3121           BMP flight 2012-09-08a
G   10        0         0              Test 2012-09-05a
H   9         0         0              Test 2012-09-05a
I   8         0         0              Test 2012-09-03f
J   7         0         0              Test 2012-09-03f
K   6         2235      3451           Test 2012-09-03f
L   5         2190      3525           Test 2012-[-03e
M   4         2201      3566           Test 2012-F-03d
N   3         2229      3596           Test 2012-?-03c
O   2         2176      3459           Test 2012-n-03b
P   1         2167      3520           i
```

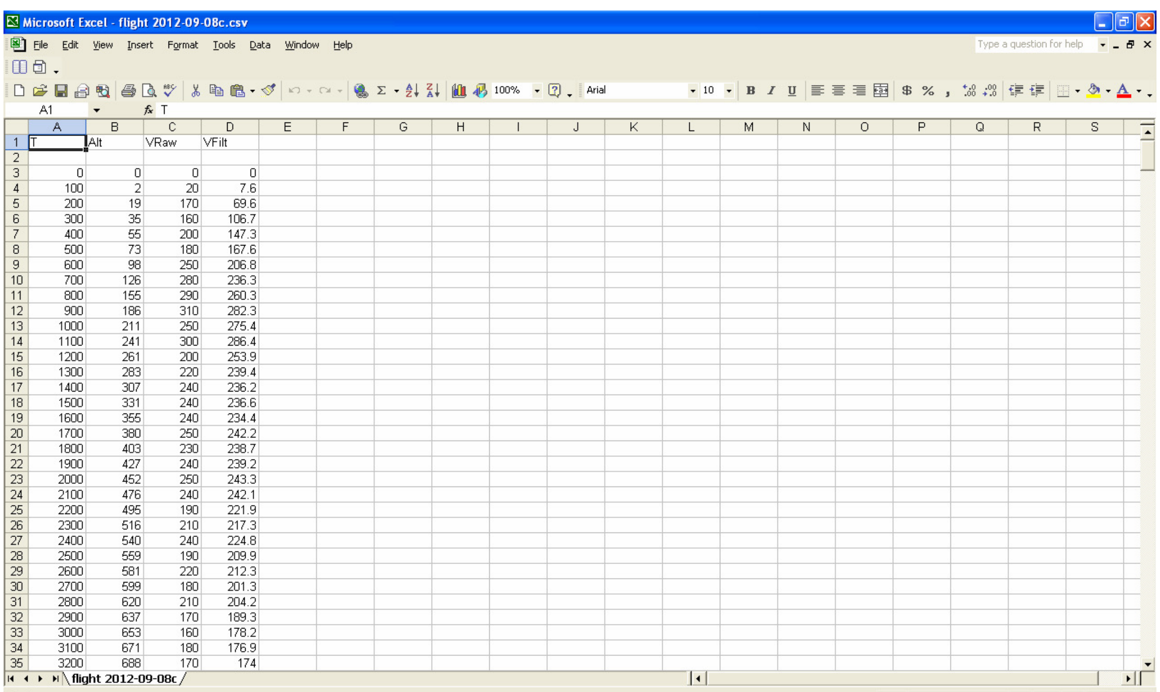
We're going to pick flight "A" in Page 0. Note that there's a lot of junk on this page, we did a lot of bench testing prior to the flight. This is actual data from a real flight, the rocket was an Estes Vagabond with a payload section added, the motor was an Aerotech 24/40 RMS E28-7. When prompted, press the button and download the summary data, but we're not going to do anything with it. After the summary data is finished, open up the "download to file" buffer on your terminal program, and we'll give it the name "flight 2012-09-08c.csv". It's important that the extension is ".csv", it makes it easier for Excel to find it. Press the button and download the data, when it's done close the buffer, close your terminal program, and power off your Eggtimer.

Importing the Data into Excel

Launch Excel, browse to the file that you downloaded and open it. Note that you may have to change the file types that it's looking for, to "text files"…



Opening up the file gives us this:



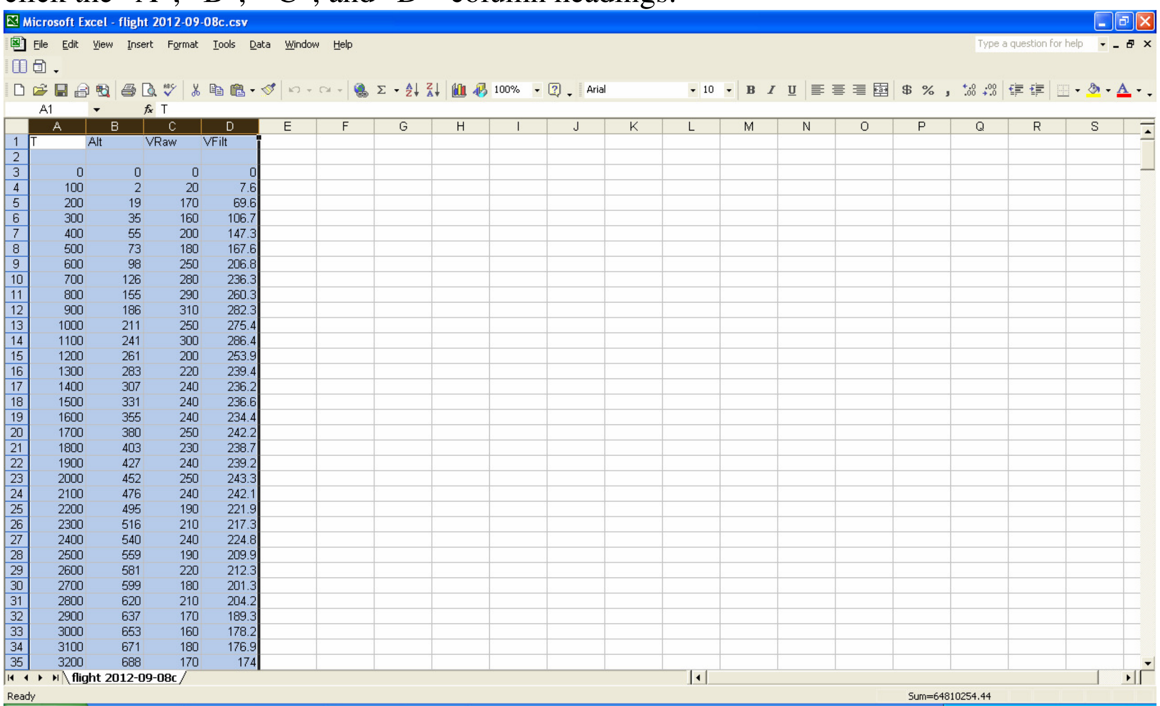
	A	B	C	D
1	T	Alt	VRaw	VFilt
2				
3	0	0	0	0
4	100	2	20	7.6
5	200	19	170	69.6
6	300	35	160	106.7
7	400	55	200	147.3
8	500	73	180	167.6
9	600	98	250	206.8
10	700	126	280	236.3
11	800	155	290	260.3
12	900	186	310	282.3
13	1000	211	250	275.4
14	1100	241	300	286.4
15	1200	261	200	253.9
16	1300	283	220	239.4
17	1400	307	240	236.2
18	1500	331	240	236.6
19	1600	355	240	234.4
20	1700	380	250	242.2
21	1800	403	230	238.7
22	1900	427	240	239.2
23	2000	452	250	243.3
24	2100	476	240	242.1
25	2200	495	190	221.9
26	2300	516	210	217.3
27	2400	540	240	224.8
28	2500	559	190	209.9
29	2600	581	220	212.3
30	2700	599	180	201.3
31	2800	620	210	204.2
32	2900	637	170	189.3
33	3000	653	160	178.2
34	3100	671	180	176.9
35	3200	688	170	174

This is the raw data dump. The “T” column is the elapsed time in milliseconds, the “Alt” column is the altitude from the sensor, and the “VRaw” column is the velocity derived from the difference between Altitude between two successive samples divided by the time interval between them. “VFilt” is the filtered velocity data, using a curve smoothing routine to eliminate noise due to sampling errors.

Graphing the Data

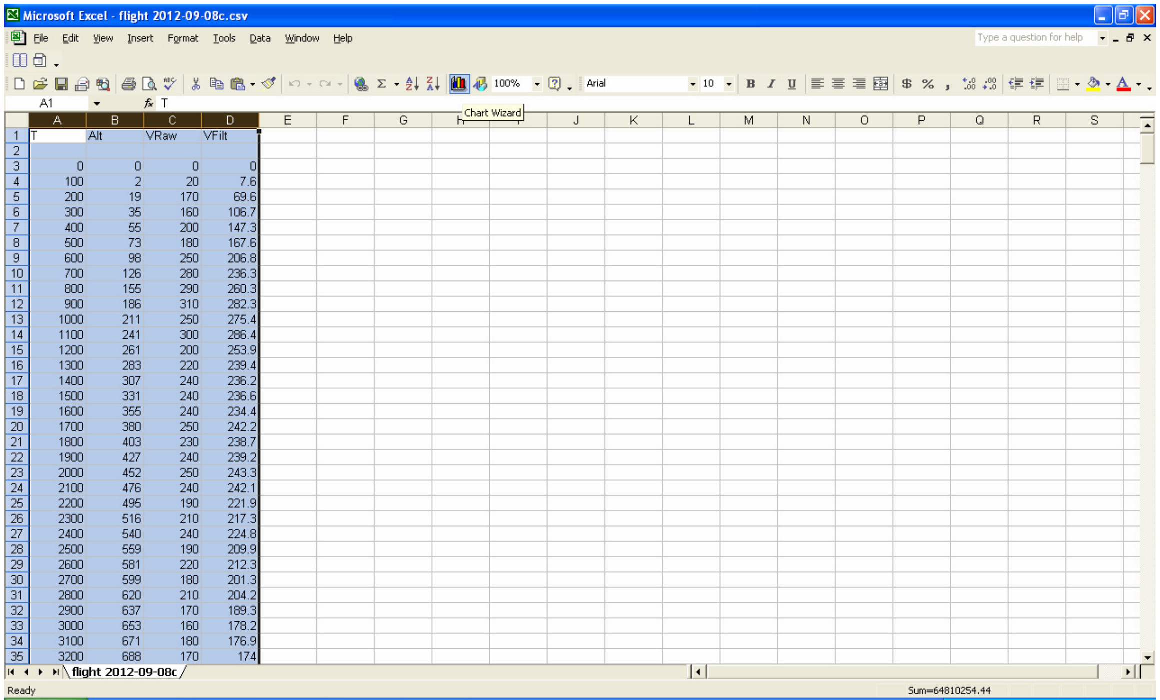
We’re going to create a graph that has both Altitude and Velocity displayed vs Time. This is a good graph for showing you what your rocket was doing, because you can easily see how things change over time.

Highlight the T, Alt, VRaw, and VFilt columns by holding the Ctrl key down while you click the “A”, “B”, “C”, and “D” column headings:

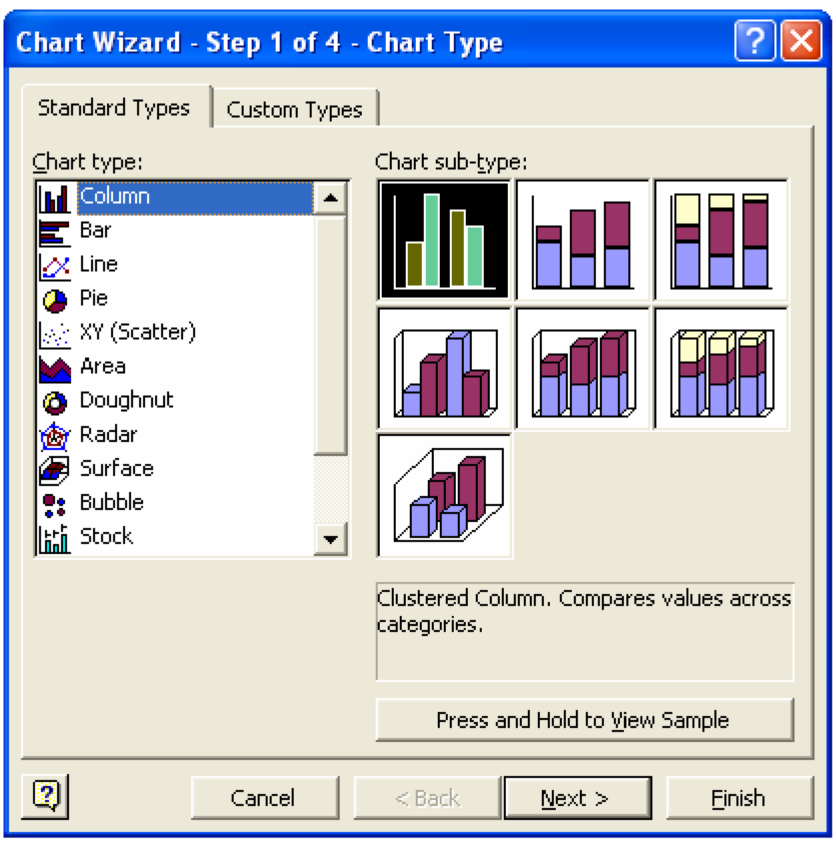


T	Alt	VRaw	VFilt
0	0	0	0
100	2	20	7.6
200	19	170	69.6
300	35	160	106.7
400	55	200	147.3
500	73	180	167.6
600	98	250	206.8
700	126	280	236.3
800	155	290	260.3
900	186	310	282.3
1000	211	250	275.4
1100	241	300	286.4
1200	261	200	253.9
1300	283	220	239.4
1400	307	240	236.2
1500	331	240	236.6
1600	355	240	234.4
1700	380	250	242.2
1800	403	230	238.7
1900	427	240	239.2
2000	452	250	243.3
2100	476	240	242.1
2200	495	190	221.9
2300	516	210	217.3
2400	540	240	224.8
2500	559	190	209.9
2600	581	220	212.3
2700	599	180	201.3
2800	620	210	204.2
2900	637	170	189.3
3000	653	160	178.2
3100	671	180	176.9
3200	688	170	174

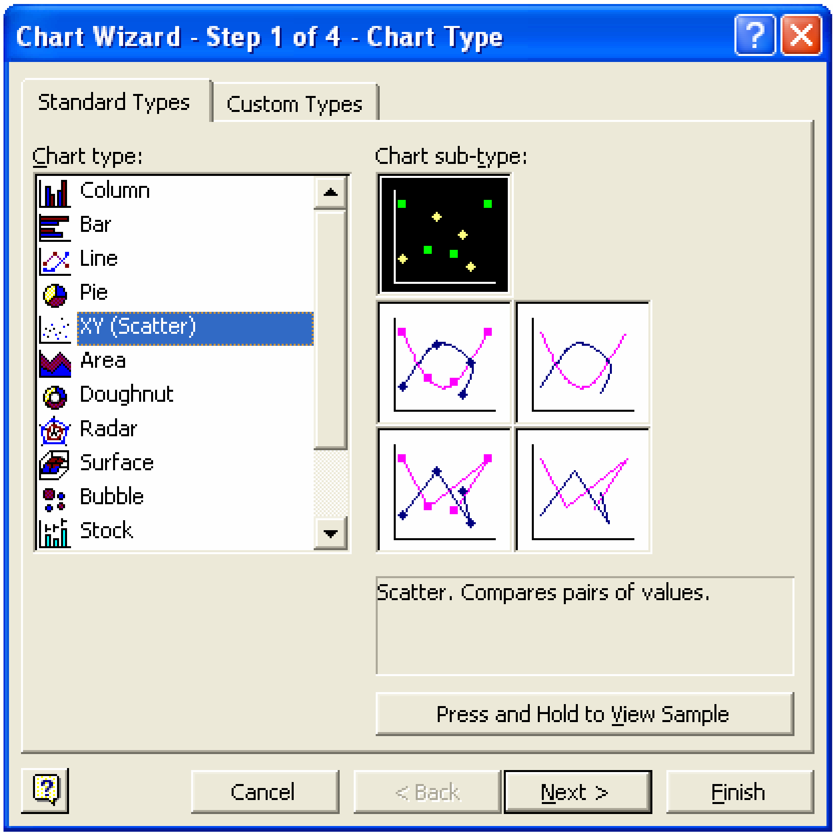
Then, click the Chart Wizard icon on the Toolbar…



You will see this screen:

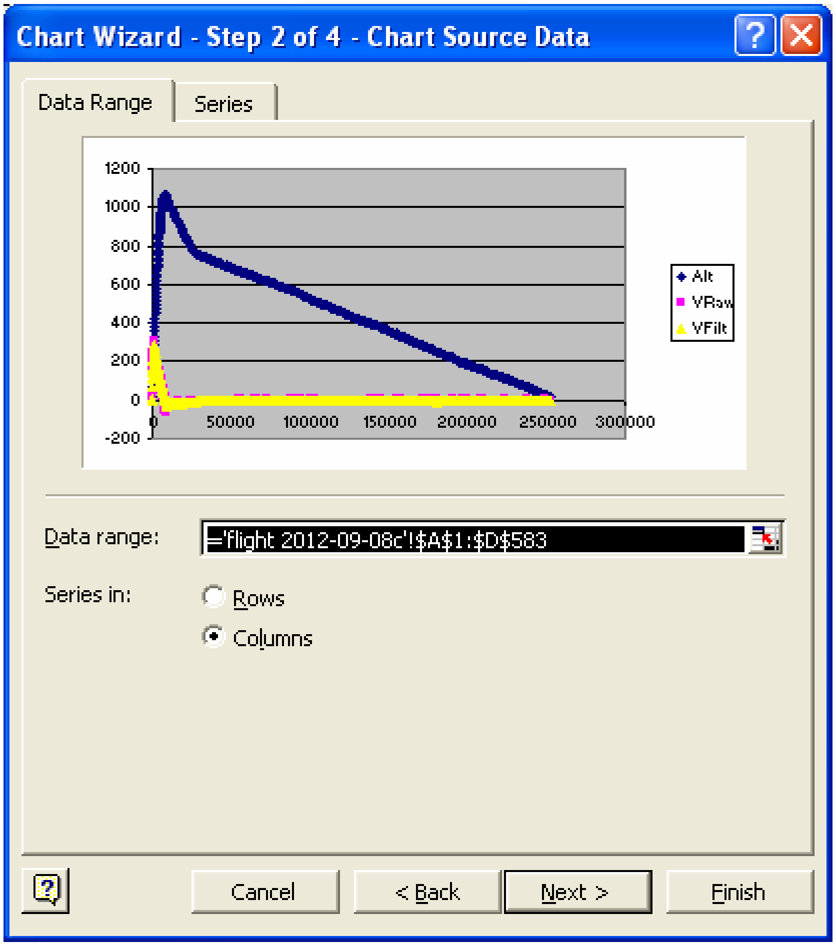


Put your cursor on the “XY (Scatter)” Chart Type and click it.

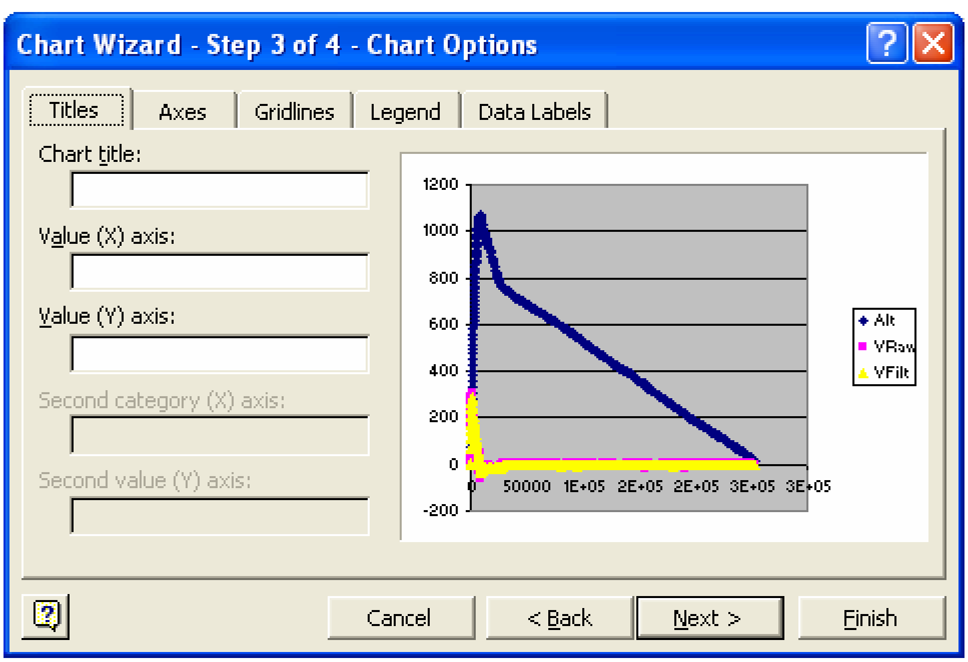


We recommend taking the default Chart sub-type, although once you’ve done this a few times you can play with it to see if you like one chart better than another.

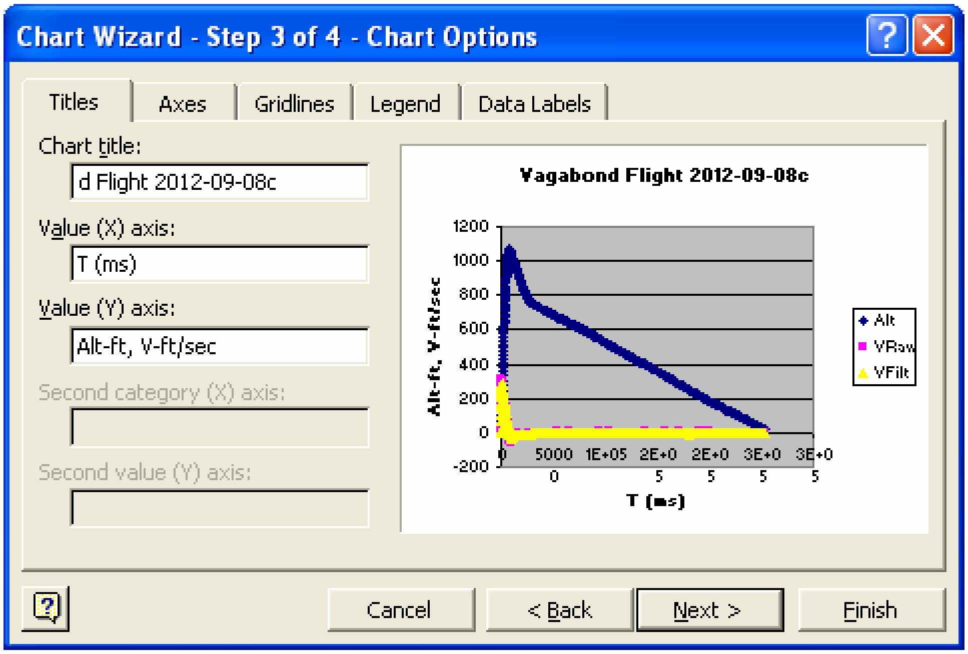
Click on Next…



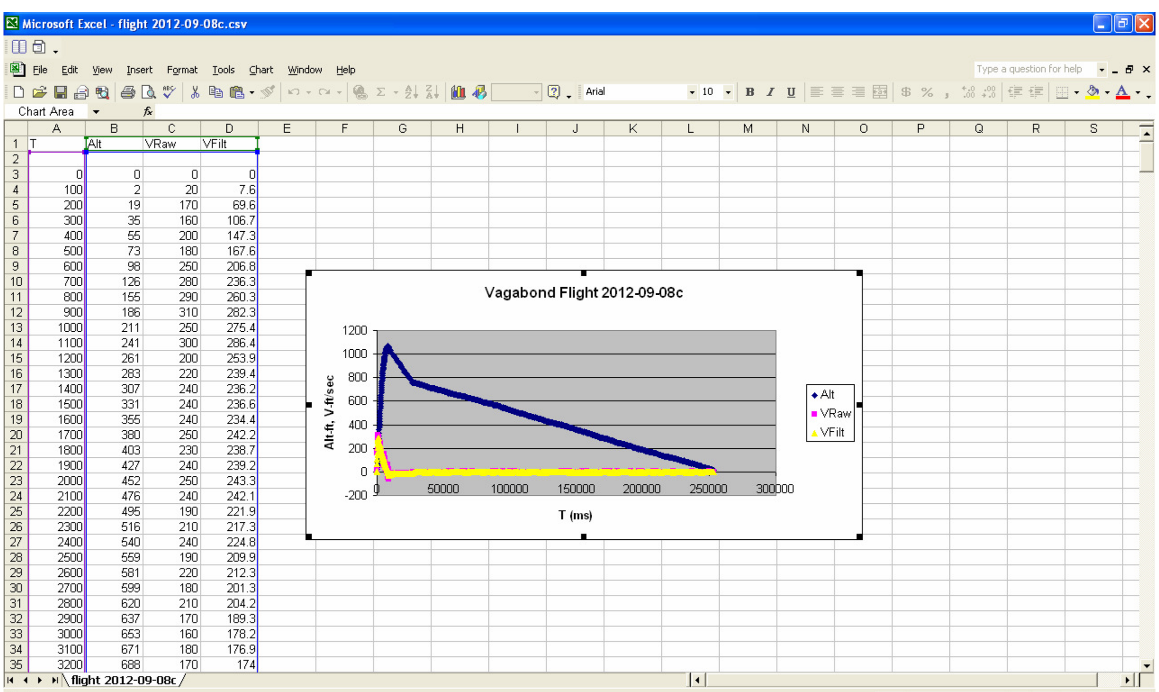
You will get a thumbnail picture of what your graph is going to look like. Click on the Next button again…



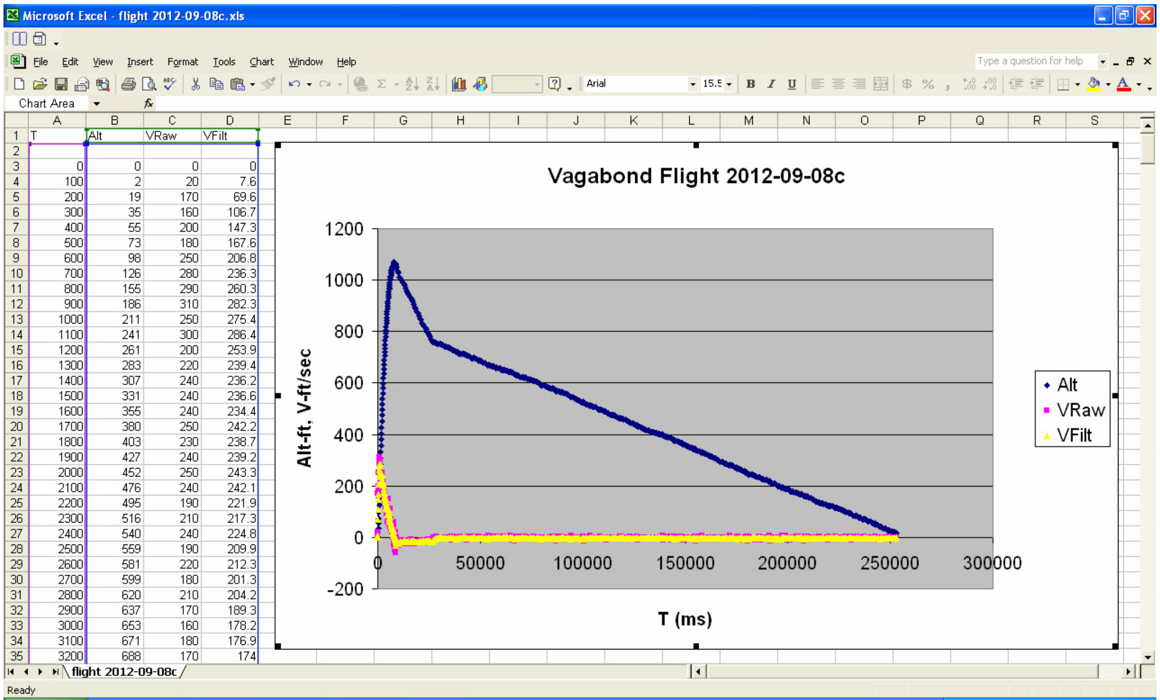
You can give the chart a title, we recommend using one that means something like "Vagabond Flight 2012-09-08c". The X axis will always be time in milliseconds, so you can put something like "T (ms)" if you want. The Y axis is being used for both Altitude in feet, and Velocity in ft/sec, so if you want you can put "Alt-ft, V-ft/sec" or something like that.



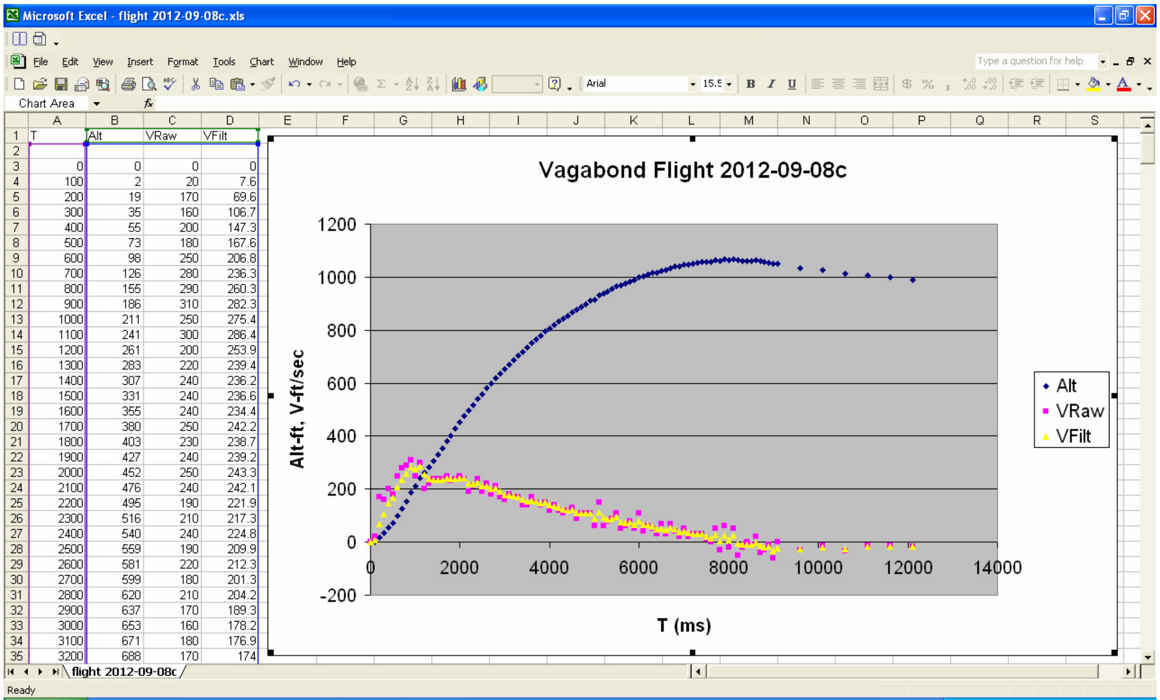
Click on Next. You will get a window that gives you the option of creating a new sheet or inserting the chart into the current spreadsheet. We'll put it into the existing sheet… click on Finish and this is what we get.



At this point you will want to do a Save As and make the file type “Excel spreadsheet” which will be .xls or .xlsx depending on your version of Excel.   After you have saved it, you can rescale the graph (the default size is a little small for any kind of analysis), move it to a new tab, etc.



If you want to just see the interesting stuff, i.e. the “up” part of the flight, you can similarly select only the ranges A1::C100, which in this case pretty much covers it:



T	Alt	VRaw	VFilt
0	0	0	0
100	2	20	7.6
200	19	170	69.6
300	35	160	106.7
400	55	200	147.3
500	73	180	167.6
600	98	250	206.8
700	126	280	236.3
800	155	290	260.3
900	186	310	282.3
1000	211	250	275.4
1100	241	300	286.4
1200	261	200	253.9
1300	283	220	239.4
1400	307	240	236.2
1500	331	240	236.6
1600	355	240	234.4
1700	380	250	242.2
1800	403	230	238.7
1900	427	240	239.2
2000	452	250	243.3
2100	476	240	242.1
2200	495	190	221.9
2300	516	210	217.3
2400	540	240	224.8
2500	559	190	209.9
2600	581	220	212.3
2700	599	180	201.3
2800	620	210	204.2
2900	637	170	189.3
3000	653	160	178.2
3100	671	180	176.9
3200	688	170	174

You can clearly see the Alt graph rising sharply then leveling off as the rocket coasts to apogee. The dots are close together because the sampling rate was 10 samples/sec, you will see the dots spread out after apogee as Nose-Over is detected and the sample rate changes (in this case, it was 2 samples /sec).

You can also see from the velocity graph that there is a definite rise and peak at about 1000 ms, then it begins to drop off. This is where burnout occurs, if you look at the specs for an Aerotech RMS 24/40 E28 motor the certified burn time is approximately 1.2 seconds, so this matches closely with predicted motor performance. The drop in velocity is the coast, you will see it drop below zero and continue to decrease as the rocket noses over and begins to freefall.

When the parachute deploys at about 8 ½ seconds, you will see a sudden up-down “bump” in the velocity as the jerking of the payload section causes a disturbance in the airflow; this is normal, and is a good indication of ejection activity. After that, the velocity increases a little but still stays negative, as the rocket falls slowly to the ground. In this case it was very slowly, it was a hot day in the desert and we caught a thermal…

You can also see the effect of the velocity smoothing routine on the data. Notice how the yellow smoothed line is much less jagged than the pink raw velocity data line. This is good for giving you an idea of the trend of the velocity over time (i.e. acceleration), but you will also see that the peak values are somewhat lower. In this case, the raw peak velocity is 310 ft/sec, the smoothed peak velocity is 286 ft/sec. Which one is “correct”? The answer is either both, or neither… because of factors mentioned in the Eggtimer User Guide, you have to take derived values with a grain of salt. They ARE a good ballpark indicator, so you can probably tell your friends with a pretty good degree of confidence that your rocket went about 300 ft/sec.