Dynamically Similar Values

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The identified parameters listed in the table below are followed by the corresponding ***Dynamically Scaled Values*** on the right which are provided in a decimal or fractional measurement of a full scale aircrafts corresponding parameter. These should be used to calculate a scale models dynamically similar value. The table calculates scale factors for ***"K"*** which are decreased from 1/2 to 1/10 of full size aircraft.

This chart was born from a truck load of research gathered to develop an efficient airfoil for a 1/4 scale P47 project as well as other common disagreements that seem to loom over various scale modeling meets that I've had the privilege of attending. An an example:

What is Scale Speed? How many times have you heard at the field "well the full size P-47D-30 (for example) had a top speed of 428 mph so a 1/5 scale should fly at 85.6 mph (428 mph times 20%), that's what scale would be!" ***Not True!*** If you use this example and the factors in the chart below, a 1/5 scale model should have a top speed of 174.62 mph to be dynamically similar to its full scale equivalent. Since a P-47D-30 had a cruising speed of 350 mph, than scale cruising speed for the judges of a 1/5 scale version should be 142.8 mph. Also the P-47D-30 had a landing threshold speed of 105 mph, or at 1/5 scale 42.84 mph - that's why you might feel that this particular 1/5 scale model flying around at 50 mph looks a little like it's going to fall out of the sky!

Enlarging/ Reducing Plans & Wing Efficiency? In modeling and UAV development, compromises in weight from those determined below may be necessary due to inadequate runway facilities, engine size (power), air density (elevation), desired performance imbalance (3D flying) and/or piloting skills. Such deviations are unavoidable particularly as model sizes (Scale Factors) are decreased significantly. Also, Reynolds Numbers are distorted when enlarging/reducing scale plans, therefore lift efficiencies are greatly decreased depending on the final Models or UAV's scale size selected. While the plane may fly many of the efficiencies or total airframe balanced may be lost. (Thanks Pat! - Advanced Aero Technologies, St Paul, MN)

Scale Factor of Full Size	K	**	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/10
Acceleration	a	K^0	---------- Acceleration Does Not Change With Scale ----------							
Dimensions	L	K^1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/10
Areas	S	K^2	1/4	1/9	1/16	1/25	1/36	1/49	1/64	1/100
Volumes	v	K^3	1/8	1/27	1/64	1/125	1/216	1/313	1/512	1/1000
Weights	W	K^3	1/8	1/27	1/64	1/125	1/216	1/343	1/512	1/1000
Forces	F	K^3	1/8	1/27	1/64	1/125	1/216	1/343	1/512	1/1000
Time	t	$K^{.5}$	0.707	0.577	0.500	0.447	0.408	0.378	0.354	0.316
Velocity	L/t	$K^{.5}$	0.707	0.577	0.500	0.447	0.408	0.378	0.354	0.316
Horsepower	HP	$K^{3.5}$	.08837	.02137	.00781	.00358	.00189	.00110	.00069	.000316
Thrust	T	K^3	1/8	1/27	1/64	1/125	1/216	1/313	1/512	1/1000
Wing Loading by Area	W/S	K^1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/10
Wing Loading by Volume	W/v	K^0	---------- Volume Wing Loading Does Not Change With Scale ----------							
Power Loading	W/HP	$1/K^{.5}$	1.414	1.730	2.000	2.237	2.451	2.652	2.833	3.165

**** Exponent of Scale Factor "K" For Each Parameter**