

LAMPIRAN 3. ORIGINAL SOURCE: Sheldahl, R. E. and Klimas, P. C., Aerodynamic

AIRFOIL: NACA 0015
DATA: Drag Coefficients

ORIGINAL SOURCE: Sheldahl, R. E. and Klimas, P. C., Aerodynamic
Characteristics of Seven Airfoil Sections Through
180 Degrees Angle of Attack for Use in Aerodynamic
Analysis of Vertical Axis Wind Turbines, SAND80-2114,
March 1981, Sandia National Laboratories, Albuquerque,
New Mexico.

NOTES: The data herein were synthesised from a combination of
experimental results and computer calculations.

The original report contains data for lower Reynolds numbers
than contained herein, but there are some anomalies, in
particular with CL at small angles of attack.

Data extended to 360 degrees of attack and glaring anomalies
corrected by L. Lazauskas. All deviations from the original
are due to L. Lazauskas.

Please refer to the original report for more details.

Drag Coefficient

	----- REYNOLDS NUMBER -----							
ALPHA	80000	160000	360000	700000	1000000	2000000	5000000	10000000
0	0.0147	0.0116	0.0091	0.0077	0.0074	0.0070	0.0068	0.0068
1	0.0148	0.0117	0.0092	0.0078	0.0075	0.0071	0.0069	0.0068
2	0.0151	0.0120	0.0094	0.0080	0.0076	0.0072	0.0070	0.0069
3	0.0156	0.0124	0.0098	0.0083	0.0079	0.0075	0.0073	0.0071
4	0.0168	0.0132	0.0105	0.0089	0.0083	0.0078	0.0075	0.0074
5	0.0181	0.0142	0.0114	0.0098	0.0091	0.0083	0.0080	0.0077

334	0.4320	0.4320	0.4320	0.4320	0.4320	0.4320	0.4320	0.4320
335	0.4050	0.4050	0.4050	0.4050	0.4050	0.4050	0.4050	0.4050
336	0.3790	0.3790	0.3790	0.3790	0.3790	0.3790	0.3790	0.3790
337	0.3540	0.3540	0.3540	0.3540	0.3540	0.3540	0.3540	0.3540
338	0.3290	0.3290	0.3290	0.3290	0.3290	0.3290	0.3290	0.3290
339	0.3050	0.3050	0.3050	0.3050	0.3050	0.3050	0.3050	0.1770
340	0.2820	0.2820	0.2820	0.2820	0.2820	0.2820	0.1660	0.0257
341	0.2600	0.2600	0.2600	0.2600	0.2600	0.1550	0.0265	0.0234
342	0.2380	0.2380	0.2380	0.2380	0.1450	0.0288	0.0240	0.0213
343	0.2170	0.2170	0.2170	0.1340	0.0303	0.0261	0.0218	0.0194
344	0.1960	0.1970	0.1240	0.0297	0.0275	0.0237	0.0198	0.0176
345	0.1770	0.1770	0.0312	0.0269	0.0249	0.0215	0.0180	0.0161
346	0.1580	0.1040	0.0283	0.0244	0.0225	0.0195	0.0164	0.0147
347	0.1400	0.0302	0.0257	0.0221	0.0205	0.0177	0.0149	0.0134
348	0.1230	0.0281	0.0233	0.0200	0.0186	0.0161	0.0136	0.0123
349	0.0760	0.0256	0.0211	0.0182	0.0168	0.0146	0.0124	0.0114
350	0.0277	0.0233	0.0191	0.0164	0.0152	0.0133	0.0113	0.0103
351	0.0255	0.0212	0.0173	0.0149	0.0138	0.0121	0.0102	0.0096
352	0.0234	0.0193	0.0157	0.0135	0.0126	0.0108	0.0095	0.0090
353	0.0214	0.0176	0.0143	0.0122	0.0111	0.0098	0.0089	0.0086
354	0.0197	0.0160	0.0126	0.0108	0.0101	0.0090	0.0084	0.0081
355	0.0181	0.0142	0.0114	0.0098	0.0091	0.0083	0.0080	0.0077
356	0.0168	0.0132	0.0105	0.0089	0.0083	0.0078	0.0075	0.0074
357	0.0156	0.0124	0.0098	0.0083	0.0079	0.0075	0.0073	0.0071
358	0.0151	0.0120	0.0094	0.0080	0.0076	0.0072	0.0070	0.0069
359	0.0148	0.0117	0.0092	0.0078	0.0075	0.0071	0.0069	0.0068

AIRFOIL: NACA 0015
DATA: Lift Coefficients

ORIGINAL SOURCE: Sheldahl, R. E. and Klimas, P. C., Aerodynamic Characteristics of Seven Airfoil Sections Through 180 Degrees Angle of Attack for Use in Aerodynamic Analysis of Vertical Axis Wind Turbines, SAND80-2114, March 1981, Sandia National Laboratories, Albuquerque, New Mexico.

NOTES: The data herein were synthesised from a combination of experimental results and computer calculations.

The original report contains data for lower Reynolds numbers than contained herein, but there are some anomalies, in particular with CL at small angles of attack.

Data extended to 360 degrees of attack and glaring anomalies corrected by L. Lazauskas. All deviations from the original are due to L. Lazauskas.

Please refer to the original report for more details.

Lift Coefficient

	----- REYNOLDS NUMBER -----							
ALPHA	80000	160000	360000	700000	1000000	2000000	5000000	10000000
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100
2	0.2200	0.2200	0.2200	0.2200	0.2200	0.2200	0.2200	0.2200
3	0.3300	0.3300	0.3300	0.3300	0.3300	0.3300	0.3300	0.3300
4	0.4186	0.4400	0.4400	0.4400	0.4400	0.4400	0.4400	0.4400
5	0.5180	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500	0.5500
6	0.6048	0.6299	0.6600	0.6600	0.6600	0.6600	0.6600	0.6600
7	0.6760	0.7150	0.7390	0.7483	0.7700	0.7700	0.7700	0.7700

210	0.7700	0.7700	0.7700	0.7700	0.7700	0.7700	0.7700	0.7700
215	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000
220	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800	0.9800
225	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300
230	0.8500	0.8500	0.8500	0.8500	0.8500	0.8500	0.8500	0.8500
235	0.7600	0.7600	0.7600	0.7600	0.7600	0.7600	0.7600	0.7600
240	0.6700	0.6700	0.6700	0.6700	0.6700	0.6700	0.6700	0.6700
245	0.5750	0.5750	0.5750	0.5750	0.5750	0.5750	0.5750	0.5750
250	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
255	0.3200	0.3200	0.3200	0.3200	0.3200	0.3200	0.3200	0.3200
260	0.1850	0.1850	0.1850	0.1850	0.1850	0.1850	0.1850	0.1850
265	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500
270	-0.0900	-0.0900	-0.0900	-0.0900	-0.0900	-0.0900	-0.0900	-0.0900
275	-0.2300	-0.2300	-0.2300	-0.2300	-0.2300	-0.2300	-0.2300	-0.2300
280	-0.3650	-0.3650	-0.3650	-0.3650	-0.3650	-0.3650	-0.3650	-0.3650
285	-0.5000	-0.5000	-0.5000	-0.5000	-0.5000	-0.5000	-0.5000	-0.5000
290	-0.6300	-0.6300	-0.6300	-0.6300	-0.6300	-0.6300	-0.6300	-0.6300
295	-0.7600	-0.7600	-0.7600	-0.7600	-0.7600	-0.7600	-0.7600	-0.7600
300	-0.8750	-0.8750	-0.8750	-0.8750	-0.8750	-0.8750	-0.8750	-0.8750
305	-0.9550	-0.9550	-0.9550	-0.9550	-0.9550	-0.9550	-0.9550	-0.9550
310	-1.0200	-1.0200	-1.0200	-1.0200	-1.0200	-1.0200	-1.0200	-1.0200
315	-1.0500	-1.0500	-1.0500	-1.0500	-1.0500	-1.0500	-1.0500	-1.0500
320	-1.0350	-1.0350	-1.0350	-1.0350	-1.0350	-1.0550	-1.0600	-1.0700
325	-0.9800	-0.9800	-0.9820	-0.9800	-1.0200	-1.0620	-1.0800	-1.1000
330	-0.8550	-0.8550	-0.9300	-0.9600	-1.0100	-1.0700	-1.1000	-1.1200
333	-0.8277	-0.8382	-0.8788	-0.9473	-0.9912	-1.0810	-1.1397	-1.1519
334	-0.7700	-0.7771	-0.8055	-0.8838	-0.9406	-1.0591	-1.1268	-1.1374
335	-0.7156	-0.7224	-0.7511	-0.8353	-0.9023	-1.0317	-1.1322	-1.1380

336	-0.6617	-0.6685	-0.7015	-0.7961	-0.8668	-1.0078	-1.1563	-1.1538
337	-0.6078	-0.6148	-0.6528	-0.7593	-0.8408	-0.9910	-1.1611	-1.1981
338	-0.5539	-0.5611	-0.6045	-0.7298	-0.8189	-0.9827	-1.1647	-1.2767
339	-0.5001	-0.5087	-0.5616	-0.7097	-0.8063	-0.9837	-1.1771	-1.3077
340	-0.4463	-0.4575	-0.5247	-0.6990	-0.8089	-0.9954	-1.1965	-1.3325
341	-0.3927	-0.4066	-0.4908	-0.7041	-0.8226	-1.0173	-1.2242	-1.3608
342	-0.3393	-0.3567	-0.4782	-0.7305	-0.8566	-1.0510	-1.2576	-1.3897
343	-0.2873	-0.3098	-0.4851	-0.7799	-0.8996	-1.0921	-1.2917	-1.4136
344	-0.2364	-0.2665	-0.5384	-0.8401	-0.9567	-1.1356	-1.3186	-1.4233
345	-0.1861	-0.2376	-0.6350	-0.9119	-1.0145	-1.1744	-1.3298	-1.4136
346	-0.1382	-0.2371	-0.7483	-0.9801	-1.0656	-1.1962	-1.3187	-1.3825
347	-0.0967	-0.3548	-0.8562	-1.0302	-1.0957	-1.1948	-1.2847	-1.3300
348	-0.0749	-0.5936	-0.9285	-1.0508	-1.0971	-1.1667	-1.2290	-1.2591
349	-0.1642	-0.7623	-0.9572	-1.0363	-1.0686	-1.1138	-1.1553	-1.1749
350	-0.6122	-0.8322	-0.9440	-0.9937	-1.0141	-1.0433	-1.0685	-1.1000
351	-0.6969	-0.8311	-0.8946	-0.9260	-0.9387	-0.9574	-0.9900	-0.9900
352	-0.7189	-0.7851	-0.8240	-0.8442	-0.8504	-0.8800	-0.8800	-0.8800
353	-0.6760	-0.7150	-0.7390	-0.7483	-0.7700	-0.7700	-0.7700	-0.7700
354	-0.6048	-0.6299	-0.6600	-0.6600	-0.6600	-0.6600	-0.6600	-0.6600
355	-0.5180	-0.5500	-0.5500	-0.5500	-0.5500	-0.5500	-0.5500	-0.5500
356	-0.4186	-0.4400	-0.4400	-0.4400	-0.4400	-0.4400	-0.4400	-0.4400
357	-0.3300	-0.3300	-0.3300	-0.3300	-0.3300	-0.3300	-0.3300	-0.3300
358	-0.2200	-0.2200	-0.2200	-0.2200	-0.2200	-0.2200	-0.2200	-0.2200
359	-0.1100	-0.1100	-0.1100	-0.1100	-0.1100	-0.1100	-0.1100	-0.1100
