

## Martin Hepperle's MH Sections for Tailless Aircraft

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The following sections for tailless sailplanes were created a few years ago by Martin Hepperle. All require swept wing configurations, with the exception of the MH 61 which has a substantially positive pitching moment and could be used with a plank planform. In general, all are capable of creating greater lift with less drag than equivalent Eppler sections. All are designed for Reynolds numbers of 100,000 to 150,000 and higher; polars show excellent performance at  $R_n = 400,000$ .

The accompanying chart, along with Dr. Panknin's twist formula described in previous columns, can be used to determine suitable sections for a particular tailless planform.

### MH 45

Along with the MH 44 and MH 46, neither of which is described here, the MH 45 was created for the Swiss LOGO-Team. The MH 45 is capable of very high lift while being slightly positively stable. It also has the advantage of being designed to benefit from the use of flaps (25% chord). With five degrees of deflection the maximum  $C_l$  is over 1.2, while with  $10^\circ$  of deflection it can achieve a maximum  $C_l$  of nearly 1.6, according to published polars. The MH 45 is just over 9.8% thick, and should receive serious consideration when looking for a root section.

### MH 60

The MH 60 was designed to be an improvement over the Eppler 182, a very good section in its own right. The MH 60 is easily capable of producing a  $C_l$  of 0.65, while its maximum  $C_l$  is about 1.0; these values are about 0.2 higher than those of the Eppler 182. The MH 60 appears to be a better choice for a tip section than the Eppler 228. The minimum Reynolds number for the MH 60 is 150,000.

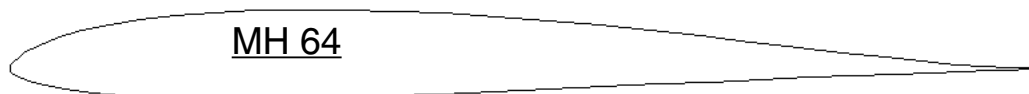
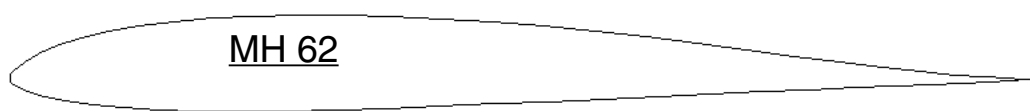
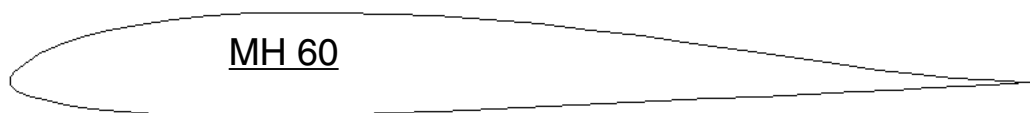
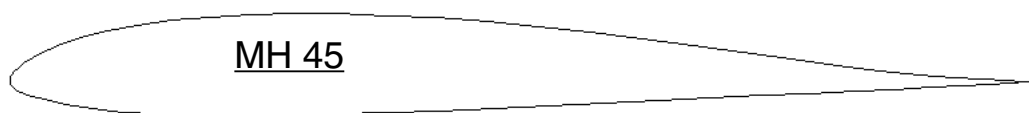
### MH 61

This section's performance is also comparable to that of the Eppler 228. The MH 61 should be used with tailless swept wings having a minimum of twist; it may also be used with plank planforms, as we mentioned previously. Minimum Reynolds number for the MH 61 is 150,000.

MH 62 and MH 64

These two sections have no Eppler equivalents. They can tolerate lower Reynolds numbers than the MH 60 and MH 61 — down to  $R_n = 100,000$ .

Section	Zero Lift Angle, $\alpha_{l=0}$	Pitching Moment, $C_m$	Thickness at %c	Camber at %c
MH 45	0.370	0.0058	9.84	
MH 60	0.420	0.0051	10.08 at 27.20	1.76 at 38.10
MH 61	-0.107	0.0175	10.28 at 29.90	1.48 at 38.10
MH 62	-0.520	-0.0004	9.30 at 26.90	1.60 at 37.00
MH 64	-0.600	-0.0050	8.61 at 26.90	1.60 at 38.80



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MH45	MH 60	MH 61	MH 62	MH 64	
1.00000	0.00000	1.00000	0.00000	1.00000	0.00000
0.99669	-0.00010	0.99666	-0.00011	0.99672	-0.00002
0.98669	-0.00021	0.98657	-0.00023	0.98684	-0.00005
0.97013	0.00016	0.96984	0.00014	0.97051	0.00042
0.94746	0.00130	0.94692	0.00134	0.94812	0.00163
0.91917	0.00332	0.91828	0.00354	0.92011	0.00371
0.88574	0.00629	0.88452	0.00691	0.88703	0.00681
0.84775	0.01028	0.84641	0.01148	0.84956	0.01096
0.80590	0.01536	0.80469	0.01708	0.80842	0.01602
0.76107	0.02140	0.76008	0.02350	0.76428	0.02179
0.71405	0.02803	0.71329	0.03043	0.71781	0.02802
0.66547	0.03488	0.66497	0.03752	0.66965	0.03440
0.61587	0.04154	0.61566	0.04434	0.62035	0.04055
0.56569	0.04768	0.56577	0.05056	0.57033	0.04619
0.51532	0.05306	0.51568	0.05594	0.52002	0.05110
0.46516	0.05755	0.46575	0.06037	0.46981	0.05515
0.41564	0.06108	0.41641	0.06378	0.42012	0.05830
0.36723	0.06358	0.36813	0.06615	0.37146	0.06051
0.32039	0.06498	0.32138	0.06741	0.32431	0.06171
0.27558	0.06523	0.27662	0.06751	0.27913	0.06186
0.23318	0.06425	0.23426	0.06640	0.23633	0.06089
0.19353	0.06203	0.19465	0.06405	0.19629	0.05879
0.15691	0.05862	0.15809	0.06048	0.15933	0.05557
0.12363	0.05410	0.12468	0.05576	0.12573	0.05127
0.09395	0.04858	0.09521	0.05000	0.09577	0.04600
0.06813	0.04218	0.06937	0.04331	0.06965	0.03985
0.04634	0.03500	0.04750	0.03581	0.04755	0.03293
0.02867	0.02722	0.02965	0.02769	0.02954	0.02544
0.01520	0.01906	0.01589	0.01929	0.01568	0.01766
0.00588	0.01088	0.00625	0.01098	0.00602	0.00997
0.00079	0.00326	0.00086	0.00335	0.00067	0.00297
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00068	-0.00279	0.00063	-0.00268	0.00067	-0.00261
0.00641	-0.00788	0.00634	-0.00782	0.00660	-0.00749
0.01781	-0.01310	0.01760	-0.01307	0.01793	-0.01248
0.03421	-0.01814	0.03387	-0.01809	0.03423	-0.01724
0.05531	-0.02277	0.05490	-0.02265	0.05525	-0.02157
0.08085	-0.02678	0.08046	-0.02657	0.08080	-0.02526
0.11065	-0.02991	0.11036	-0.02968	0.11067	-0.02817
0.14460	-0.03206	0.14441	-0.03191	0.14468	-0.03021
0.18252	-0.03329	0.18237	-0.03323	0.18261	-0.03137
0.22408	-0.03366	0.22396	-0.03370	0.22416	-0.03171
0.26891	-0.03330	0.26880	-0.03342	0.26897	-0.03132
0.31654	-0.03229	0.31644	-0.03249	0.31656	-0.03030
0.36646	-0.03073	0.36637	-0.03101	0.36646	-0.02876
0.41816	-0.02875	0.41806	-0.02908	0.41813	-0.02681
0.47104	-0.02646	0.47094	-0.02684	0.47098	-0.02458
0.52449	-0.02399	0.52438	-0.02441	0.52441	-0.02217
0.57786	-0.02143	0.57774	-0.02188	0.57775	-0.01971
0.63049	-0.01888	0.63036	-0.01933	0.63036	-0.01725
0.68174	-0.01640	0.68160	-0.01684	0.68159	-0.01488
0.73095	-0.01403	0.73082	-0.01444	0.73081	-0.01262
0.77754	-0.01179	0.77743	-0.01217	0.77742	-0.01052
0.82094	-0.00971	0.82085	-0.01006	0.82084	-0.00859
0.86062	-0.00782	0.86054	-0.00814	0.86055	-0.00687
0.89607	-0.00613	0.89601	-0.00642	0.89602	-0.00535
0.92686	-0.00465	0.92681	-0.00489	0.92683	-0.00404
0.95259	-0.00334	0.95255	-0.00353	0.95258	-0.00290
0.97293	-0.00219	0.97290	-0.00233	0.97294	-0.00190
0.98770	-0.00113	0.98767	-0.00121	0.98771	-0.00098
0.99683	-0.00031	0.99682	-0.00033	0.99684	-0.00026
1.00000	0.00000	1.00000	0.00000	1.00000	0.00000

The time will come when thou shalt lift thine eyes  
to watch a long drawn battle in the skies  
while aged peasants too amazed for words  
stare at the flying fleets of wondrous birds.

— Thomas Gray, 1737