03-05-2019

Jim Mosher

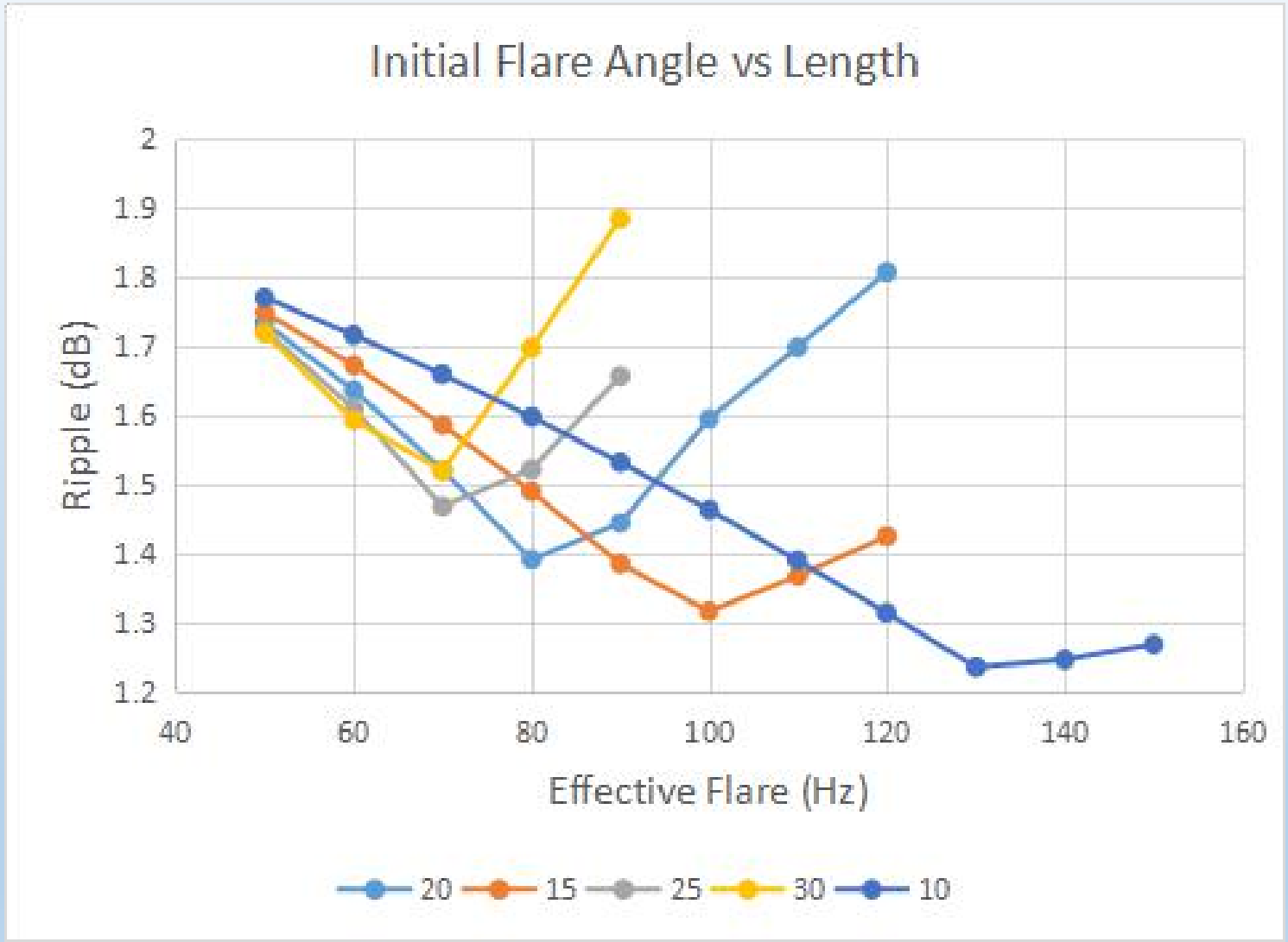
Driver Candidate and Optimum Horn Shape

This applies to the Eminence Delta Pro 12-450A Driver

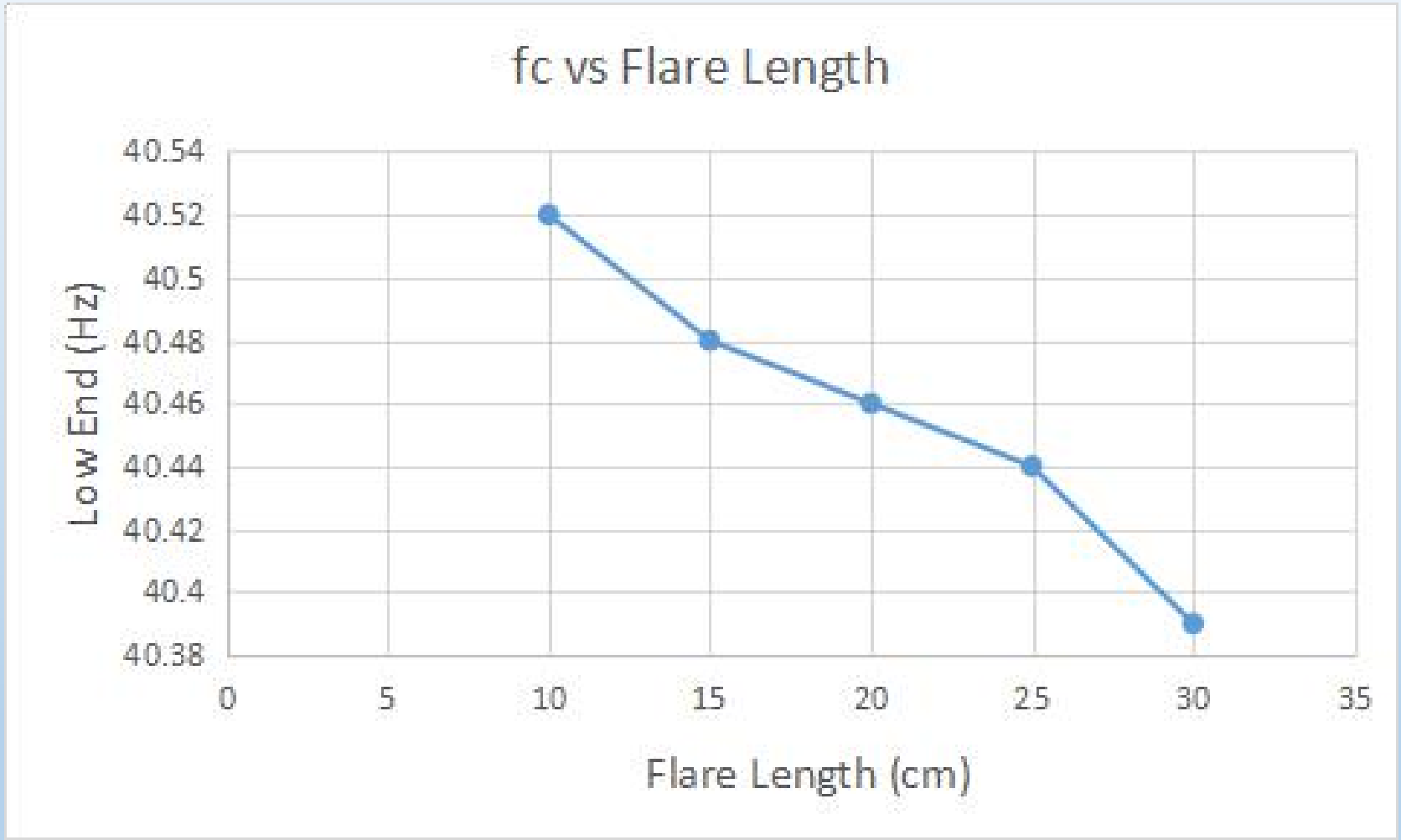
Models for 38 horn shapes, utilizing high initial flare rates are compared for acoustic performance. Below is a sampling of the data.

Eminence Delta Pro 12-450A - 44Hz						Effective Exponential										
Driver	Sd	Ratio	S1	S2	L1	Flare1	S3	Exp	Flare2	LowEnd	HiEnd	Ripple	Eff	Vrc	Record	Octaves
See above	532	3	177.3	2028	172.4	38.7				40.24	574.06	1.827	115.5	30	48	3.834
	532	3	177.3	255.4	20	49.96	2028.05	152.4	37.22	40.37	566.48	1.734	115.6	30	57	3.811
	532	3	177.3	274.8	20	59.99	2028.05	152.4	35.91	40.43	560.64	1.637	115.6	30	58	3.794
	532	3	177.3	295.7	20	70.02	2028.05	152.4	34.59	40.46	552.68	1.521	115.7	30	59	3.772
	532	3	177.3	318.1	20	80.02	2028.05	152.4	33.28	40.46	533.3	1.391	115.7	30	60	3.720
	532	3	177.3	342.2	20	90.01	2028.05	152.4	31.97	40.42	518.97	1.444	115.7	30	61	3.683
	532	3	177.3	368.1	20	100	2028.05	152.4	30.66	38.76	517.09	1.595	115.6	40	62	3.738
	532	3	177.3	395.9	20	109.97	2028.05	152.4	29.35	38.64	503.15	1.699	115.6	40	63	3.703
	532	3	177.3	426	20	120	2028.05	152.4	28.03	38.49	467.29	1.808	115.6	40	64	3.602
	532	3	177.3	233.2	15	50.02	2028.05	157.4	37.62	40.35	565.12	1.749	115.6	30	65	3.808
	532	3	177.3	246.3	15	60	2028.05	157.4	36.67	40.41	555.72	1.673	115.6	30	66	3.782
	532	3	177.3	260.2	15	70.02	2028.05	157.4	35.72	40.46	533.69	1.586	115.7	30	67	3.721
	532	3	177.3	274.8	15	79.98	2028.05	157.4	34.77	40.48	517.95	1.49	115.7	30	68	3.678
	532	3	177.3	290.3	15	90	2028.05	157.4	33.81	40.49	506.51	1.385	115.7	30	69	3.645
	532	3	177.3	306.6	15	99.97	2028.05	157.4	32.86	40.48	489.61	1.316	115.8	30	70	3.596
	532	3	177.3	323.9	15	109.99	2028.05	157.4	31.91	40.44	465.04	1.367	115.8	30	71	3.523
	532	3	177.3	342.2	15	120.02	2028.05	157.4	30.95	40.39	456.57	1.425	115.8	30	72	3.499
	532	3	177.3	279.9	25	50	2028.05	147.4	36.78	40.38	567.35	1.723	115.6	30	73	3.813
	532	3	177.3	306.7	25	60.02	2028.05	147.4	35.09	40.44	564.57	1.61	115.7	30	74	3.803
	532	3	177.3	336	25	70.01	2028.05	147.4	33.39	40.44	562.29	1.468	115.7	30	75	3.797
	532	3	177.3	368.1	25	80	2028.05	147.4	31.7	40.38	561.21	1.522	115.7	30	76	3.797
	532	3	177.3	403.3	25	90	2028.05	147.4	30	40.28	561.32	1.657	115.7	30	77	3.801
	532	3	177.3	306.7	30	50.01	2028.05	142.4	36.32	40.39	566.31	1.719	115.6	30	78	3.810

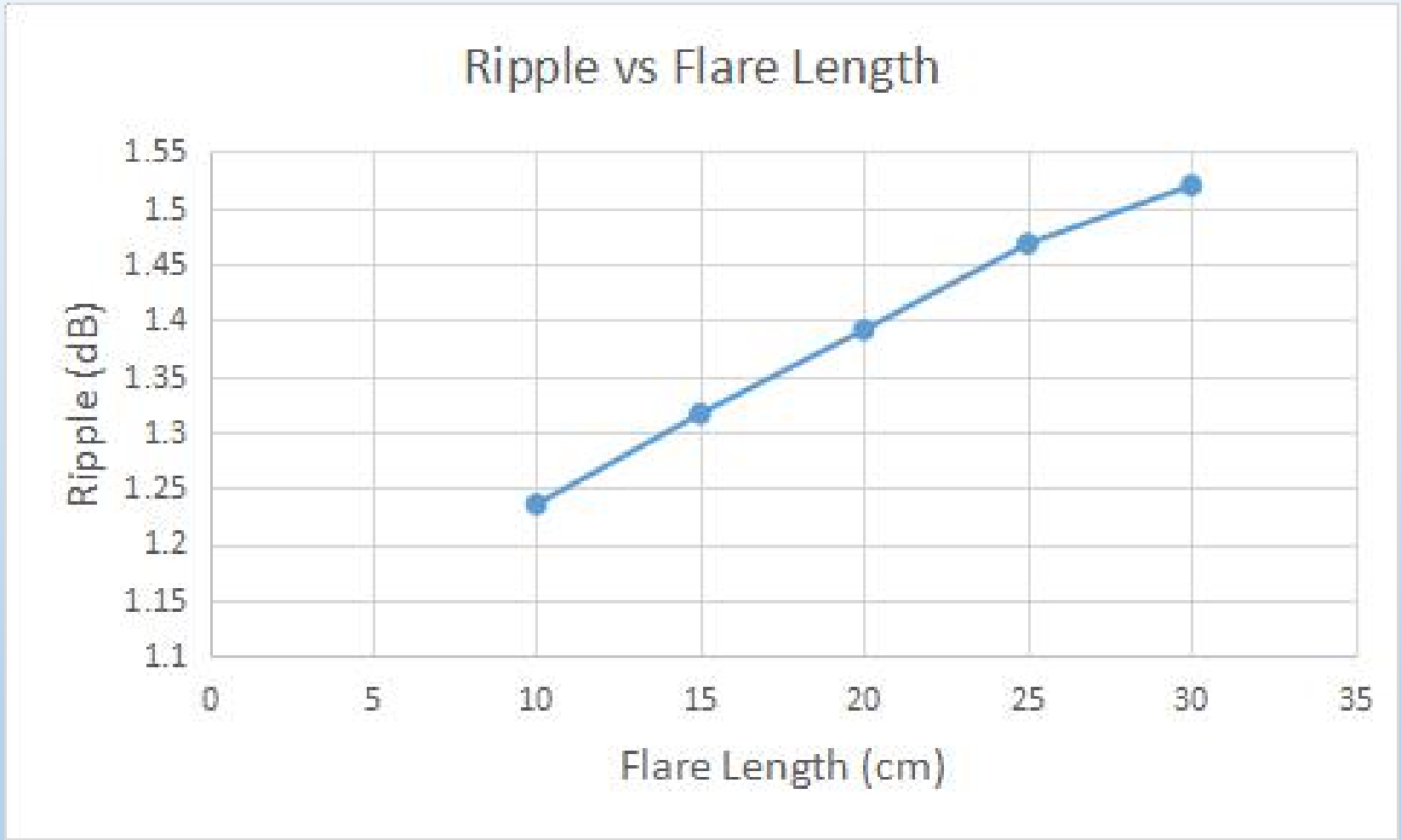
There is an optimum effective initial flare angle for each corresponding flare length. The graph at right clearly shows the optimum angle for each length, based on the amount of Ripple produced.



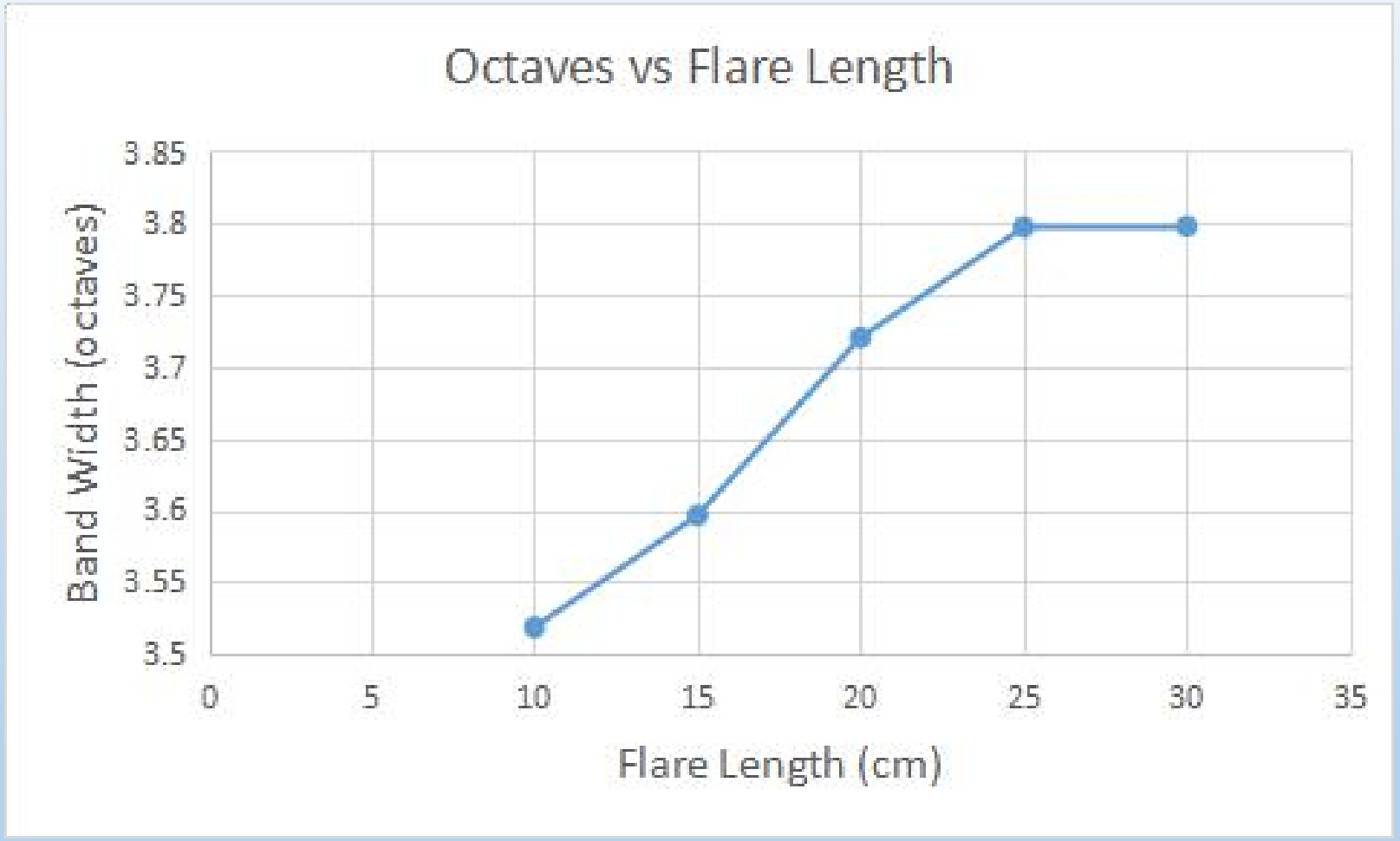
Relation between fc and Flare Length. The difference in fc is very small indeed.



Relation between Ripple and Flare Length. Making Flare Length longer also increases the Ripple in a linear fashion.



Relation between Bandwidth and Flare Length. Making Flare Length longer also increases the bandwidth.

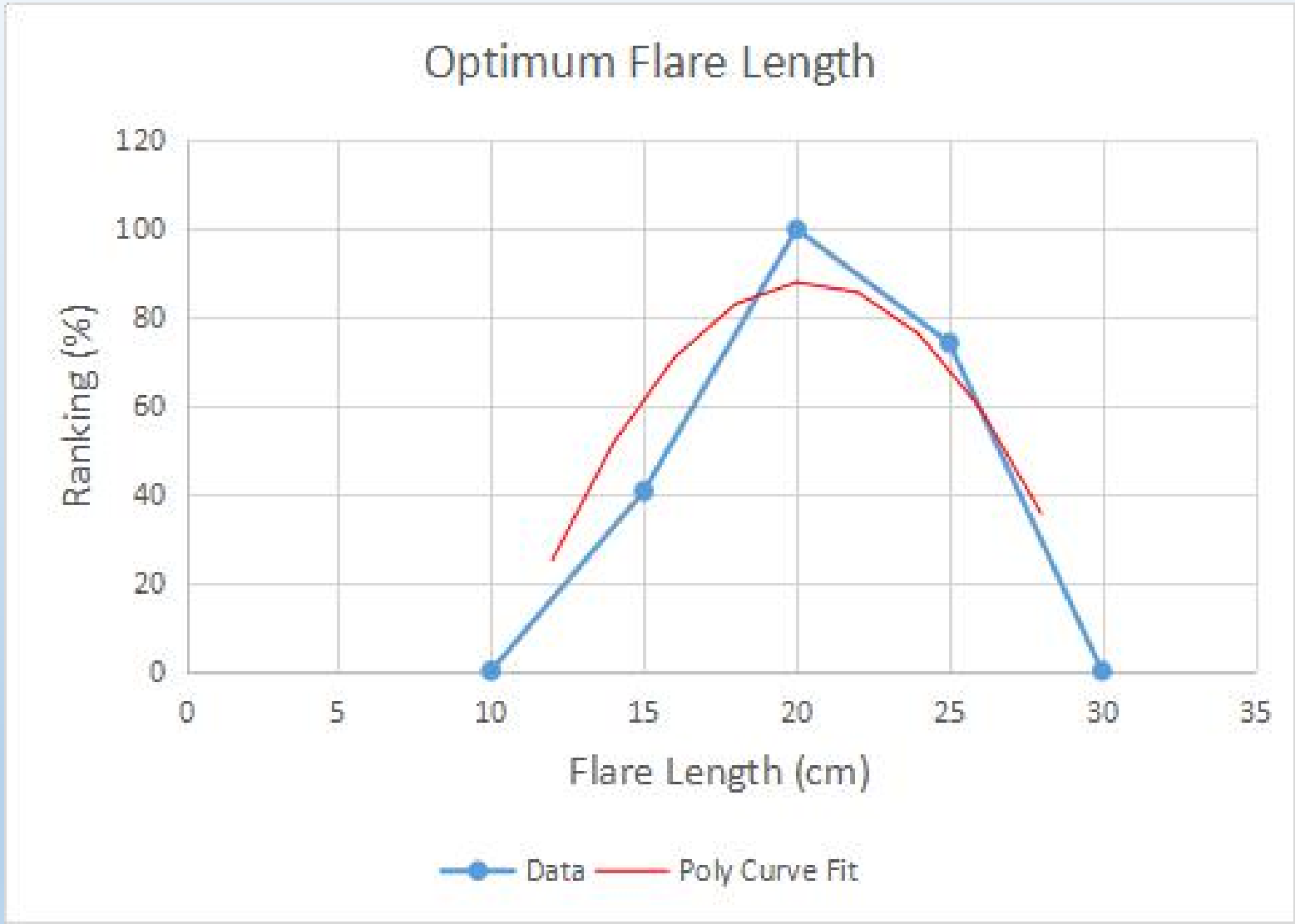


Summary data for the five primary high initial flare rates are shown. Flare lengths of 10 - 30 cm were modeled. Each flare length yielded, a LowEnd (fc), Ripple, and Bandwidth (octaves). Weighting factors were applied to each variable, such as, if the fc is desirably low then this gets a weighting of 100% and the highest fc gets zero. Linear interpolation was used model values between min/max. The same is true of a low Ripple, and again for a wide bandwidth. When these three weighting are combined, it shows the flare length with the most pluses.

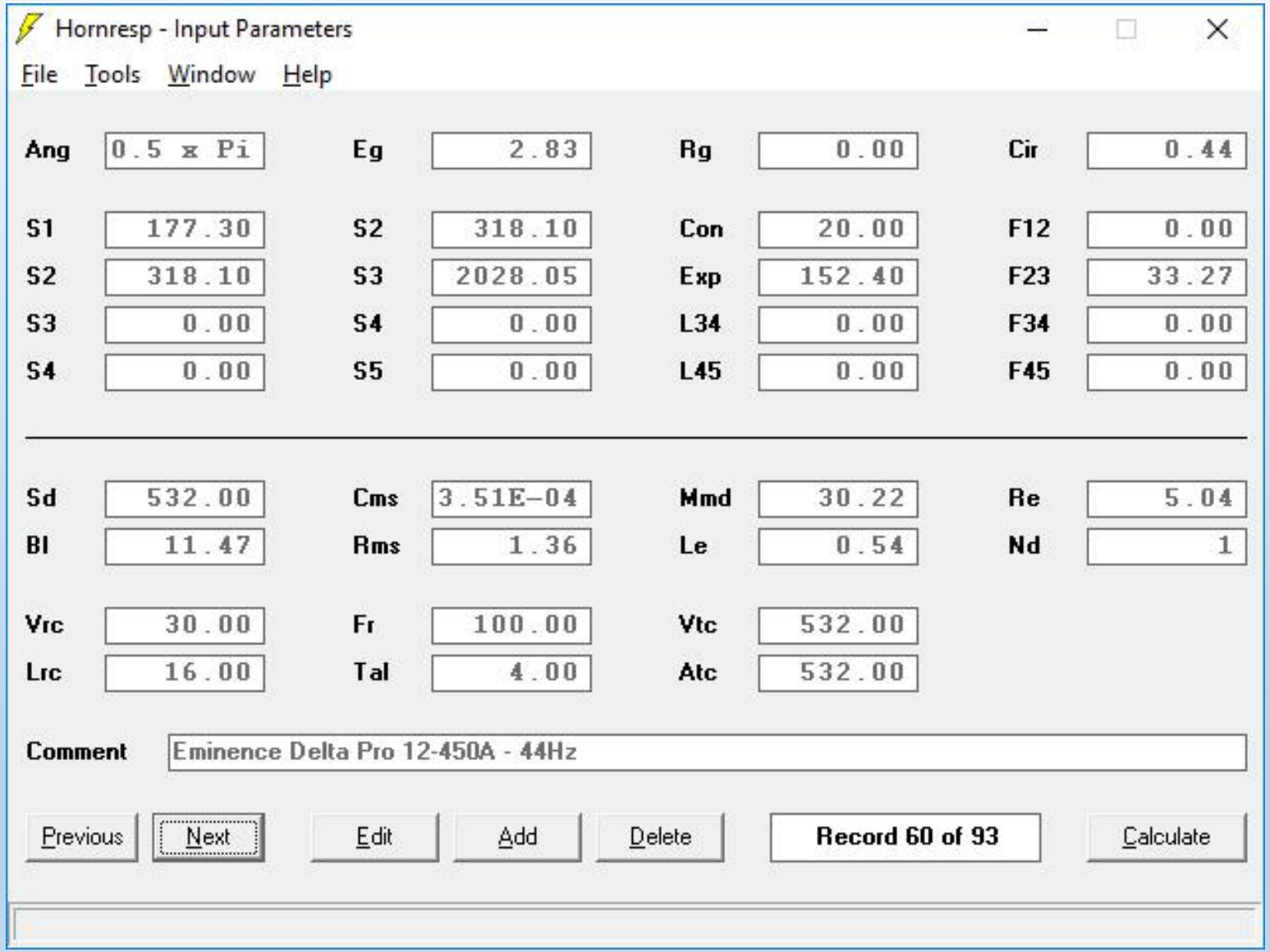
Of those, it appears that a length of 20 cm is optimum, based on low fc, low Ripple, and high bandwidth (octaves).

																		1509.42
																LowEnd	Ripple	Octaves	Rank
Summary															Max	40.39	1.235	3.797961	100
															Min	40.52	1.52	3.518351	0
Sd	Ratio	S1	S2	L1	Flare1	S3	Exp	Flare2	LowEnd	HiEnd	Ripple	Eff	Vrc	Record	Octaves				
532	3	177.3	285.1	10	130.05	2028.05	162.4	33.08	40.52	464.3	1.235	115.8	30	91	3.518351	3.51E-09	100	-1.2E-07	-2.9E-17
532	3	177.3	306.6	15	99.97	2028.05	157.4	32.86	40.48	489.61	1.316	115.8	30	70	3.596352	30.76923	71.57895	27.89625	40.70406
532	3	177.3	318.1	20	80.02	2028.05	152.4	33.28	40.46	533.3	1.391	115.7	30	60	3.720379	46.15385	45.26316	72.25354	100.0004
532	3	177.3	336	25	70.01	2028.05	147.4	33.39	40.44	562.29	1.468	115.7	30	75	3.797459	61.53846	18.24561	99.82068	74.25326
532	3	177.3	381.8	30	70	2028.05	142.4	32.11	40.39	561.79	1.52	115.7	30	80	3.797961	100	0	100	0

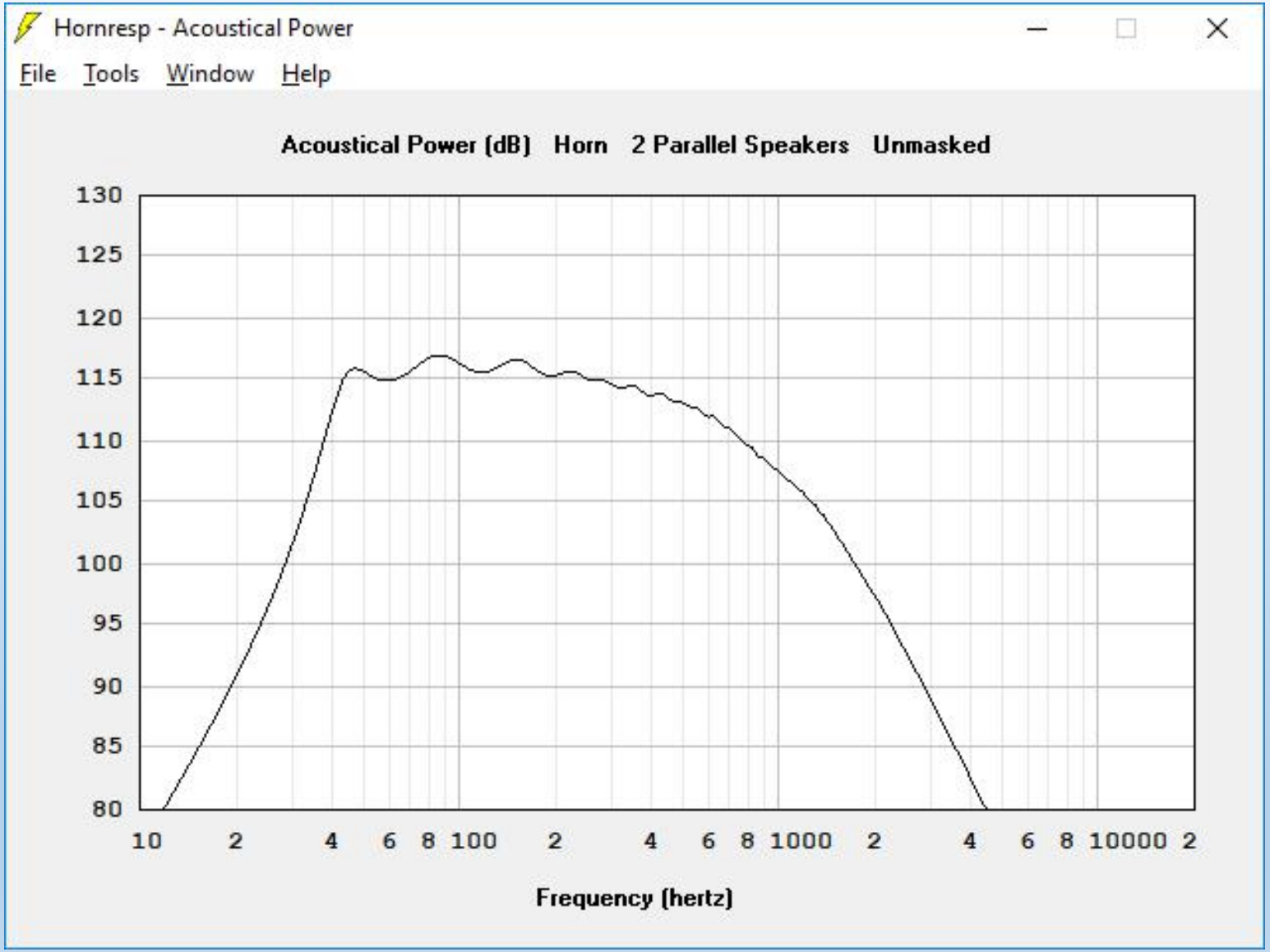
The data on right shows the raw data (blue) and a second order poly curve fit (red). The optimum flare length seems to be close to 20 cm in length.



The optimum horn shape for the Eminence driver in shown on the right. Note that this is 1/2 of the total horn volume. The horn shape will be tweaked along with changes to Vtc at a later date.



Here is the SPL data for the Eminence driver, along with the optimum horn shape.



Summary:

An optimum horn shape with high initial flare was found for the particular driver (flare length = 20cm, effective flare rate = 80Hz).

It appears that utilizing the high initial flare does not materially reduce the fc, but rather it does reduce pass band ripple by 38% (1.8 vs 1.3 dB) over a pure exponential flare.

Utilizing a high flare does also reduce the pass band over a pure exponential by about 3% in this study (3.8 vs 3.7 octaves).

Viewing slide #3 from High Initial Flare Rate - II PDF shows the optimum flare angle of 100Hz for a 20 cm length. In this study the optimum angle was 80Hz for the same length. It's apparent that modeling the horn without a driver gets results close in the same ball park.

Summary cont.:

It's interesting to note that all of the horn flares for the second (exponential) section of the horn, all had flare rates very close to 33Hz.

The acoustic efficiencies of all the horns were almost identical regardless of high initial flare length/angle.

It is obvious that Paul Klipsch had some tricks up his sleeve, in order for him to come with the idea of a high initial flare in the first place.