Verification And Assessment of Back Surface Aspheric Contact Lenses

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Back-surface aspheric contact lenses for the correction of presbyopia are becoming increasingly popular among private practitioners. An aspheric back-surface contact lens more closely conforms to the corneal surface, and at the same time provides additional plus power(or less minus power) as it gradually flattens from the lens apex to the periphery. While this provides a gradually increasing add, it can be a problem for the practitioner in verifying the lenses. The intent of this paper is to demonstrate a relatively simple method of measuring the power of a peripheral point on the aspheric lens; relate this power to the distance power of the lens ordered, and finally, to demonstrate the acuities achieved by patients fitted with these lenses. For our study, thirty-four(34) Dow-Corning Variable Focus Lenses(VFL's) were verified, then distance and near acuities were recorded at dispensing.

The problem one encounters in verifying these lenses with conventional lensometry is that the power at a particular point in the contact lens periphery can not be pinpointed. The use of a modified lens stop which utilizes the Scheiner principle overcomes this problem. The Scheiner principle states that the point of focus of a light source shined through a lens and double-holed aperture will be that point where just a single image is seen. Diagram 1 demonstrates the principle.

A light source at point A is shined through the contact lens which is centered on the double-holed aperture(modified lens stop). The only single image is seen at point Y— the point of focus of the lens. At all other points, two images iation for all lenses at each distance from apex. The average add shows a fairly smooth progression as one moves from the lens apex toward the periphery. The range of powers at each distance shows a wide variation. Also, the standard deviation indicates a relatively large fluctuation between lenses.

Graph 2 demonstrates in a more visual way, the average add and standard deviation at each distance from the apex. Again, the progression of adds shows a smooth increase, but the standard deviation varies greatly. In fact, as a percentage of the add, the standard deviation ranges from 31% at the 2.5mm distance to 119% at the 1.0mm distance.

Finally, Table 2 shows the add power measured for each lens at 1.0mm, 1.5mm, and 2.0mm from the apex. It also indicates the corresponding distance and near acuities achieved at dispensing for every lens. Noteworthy here is that despite a wide range of adds found in the lenses, acuities for the most part are very good, near and far.

Conclusion

Making use of Scheiner's principle and a few modified lensometer stops allows the practitioner to easily determine the power at a given point in the periphery of a back-surface aspheric contact lens.

The repeatability of add powers in the manufacturing of these lenses seems, at least from this data, to be rather poor. Yet, the acuities achieved with these lenses make it difficult to draw any concrete conclusions. One unknown variable here is the point on the lens periphery through which the patient looks for near tasks. Whether or not this is a fairly universal distance, or whether it varies from one individual to another is not known. Perhaps further study along these lines is necessary. Whatever the explanation, the fact remains that many people, when properly fit, have very good results with these lenses.

are seen as at points X and Z.

Utilizing the principle required the construction of modified lens stops to fit onto a lensometer.[1] An opaque contact lens was mounted to a piece of rubber P.V.C. tubing which had been cut to simulate a lens stop. Then two 0.75mm holes were drilled into the opaque contact lens at equal distances from the center. Six such lens stops were constructed with pinholes drilled from 0.5mm to 3.0mm from the apex, in 0.5mm steps. Diagram 2 shows a modified lens stop. The power at these distances from the lens apex is then easily measured on a lensometer. Of course, it is assumed that the aspheric lenses flatten equally in all directions in order to utilize the Scheiner principle in this manner.

The thirty-four VFL lenses used consisted of thirty minus lenses and four plus lenses. Each lens was measured six times with a conventional lens stop and each of the six modified lens stops for a total of forty-two measurements per lens. Care was taken to center the lens over the lens stop each time.

The mean add power at each distance was then calculated for every lens. Graph 1 shows this data. Simple visual inspection appears to indicate a relatively large fluctuation in add power from lens to lens, and from one distance from the lens apex to another. Especially notable here is an occasional negative add at the 0.5mm and 1.0mm distances as well as very high adds at the 3.0mm and sometimes 2.5mm distances.

Table 1 shows the overall add, range, and standard dev-

[1] Buckingham, Robert; Verification of Power of Back-Surface Aspheric Contact Lenses, unpublished.

REFERENCES

1. Buckingham, Robert, Verification of Power of Back-Surface Aspheric Contact Lenses, unpublished.

2. Lowther, DeFazio, Inspection of Back-Surface Aspheric Contact Lenses, American Journal of Optometry and Physiological Optics, Vol. 56 no. 8 Aug. 1979.

3. Meier, A., Lowther, GE, Measured Power Distribution Across The Bausch and Lomb Soflens(PAI) Bifocal, J.A.O.A. 54(3) 263-65, March, 1983.

DIAGRAM 1

Scheiner's Principle

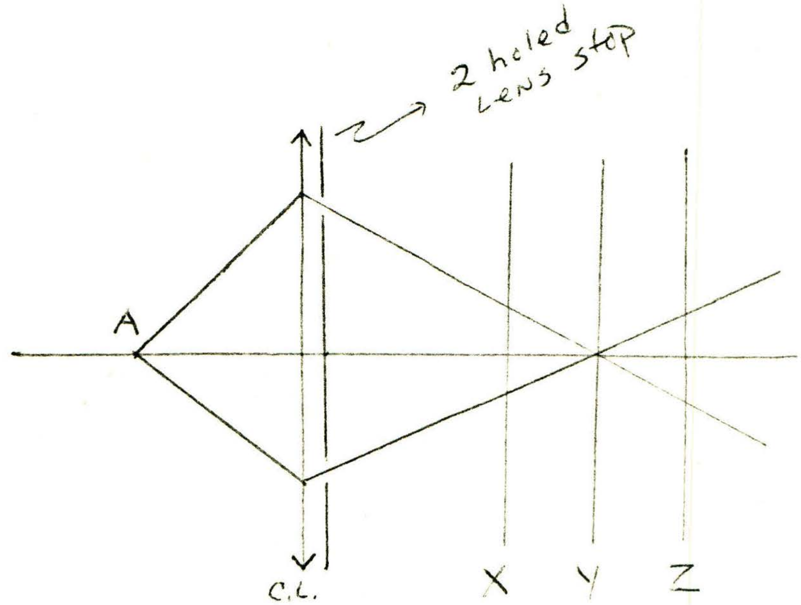
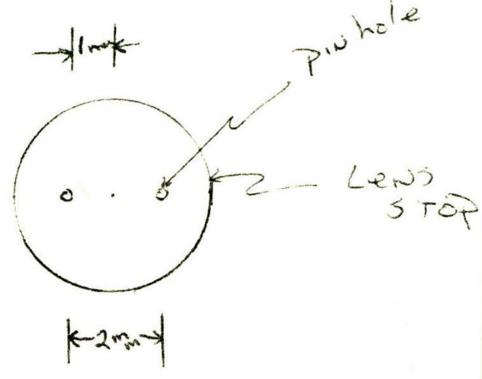


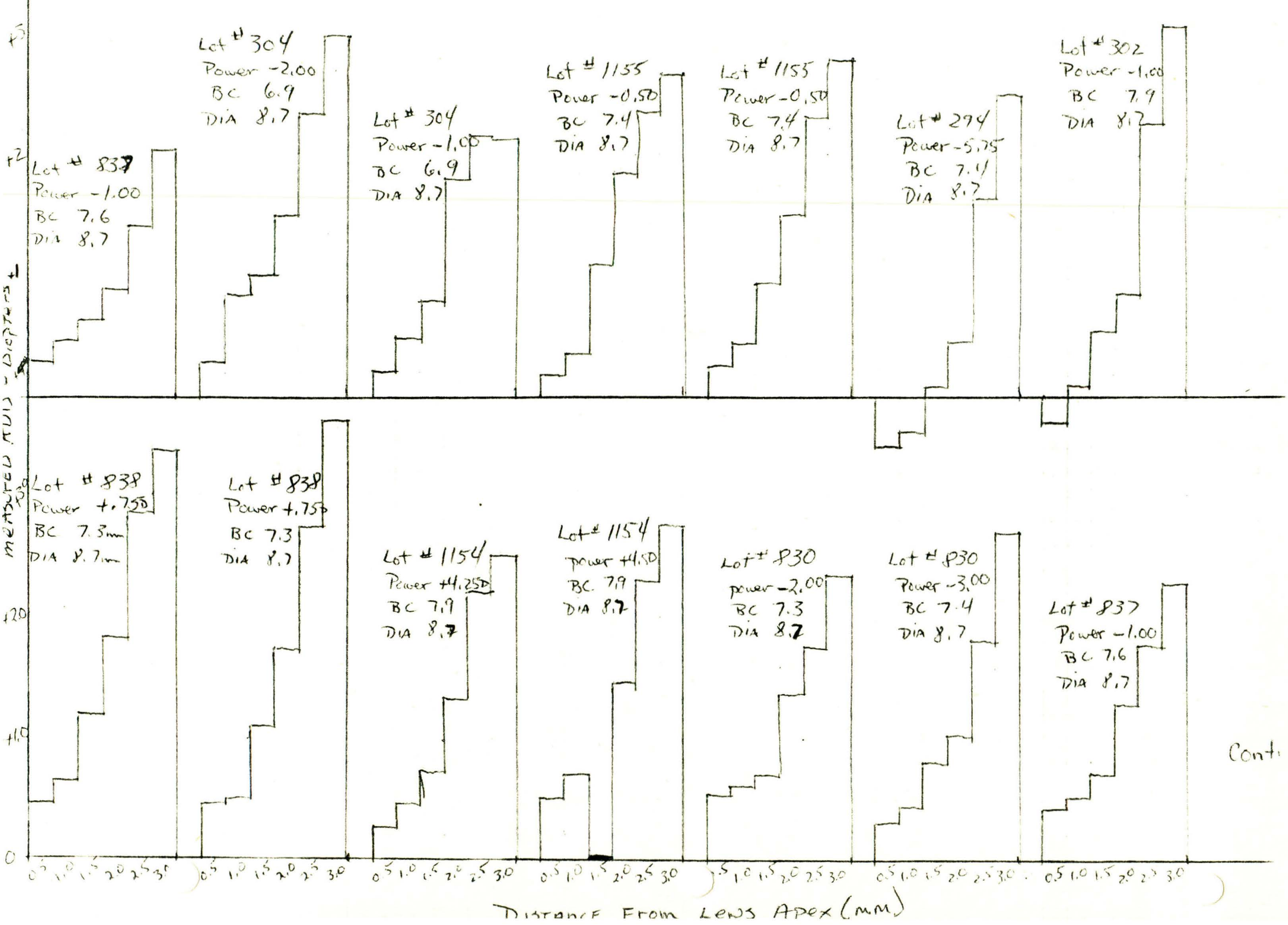
DIAGRAM 2

LENS STOP



GRAPH #1

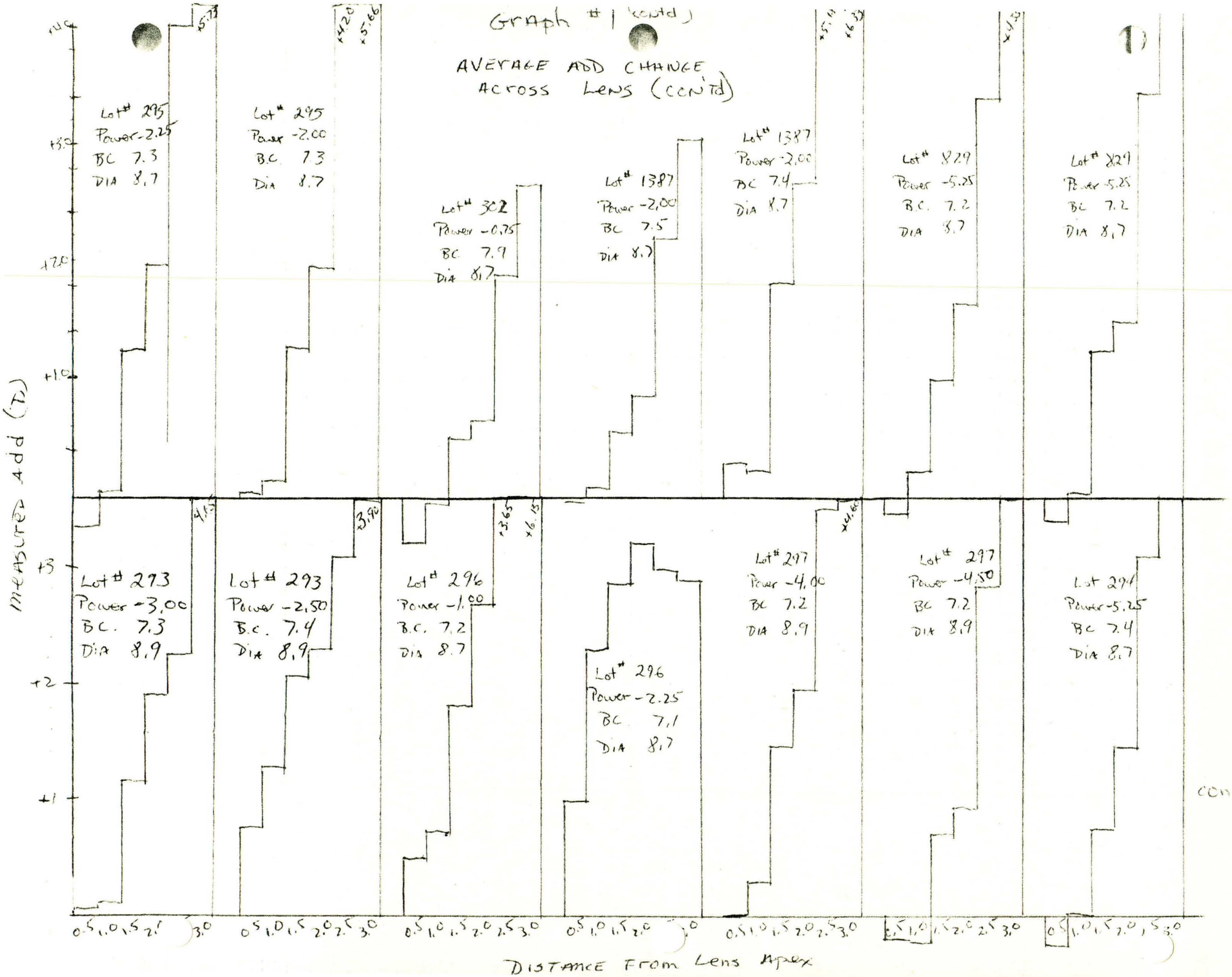
AVERAGE ADD CHANGE ACROSS LENS



Cont.

Graph #1 (contd)

AVERAGE ADD CHANGE ACROSS LENS (CONT'D)



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Graph # 1 (cont'd)

AVERAGE ADD CHANGE ACROSS LENS (cont'd)

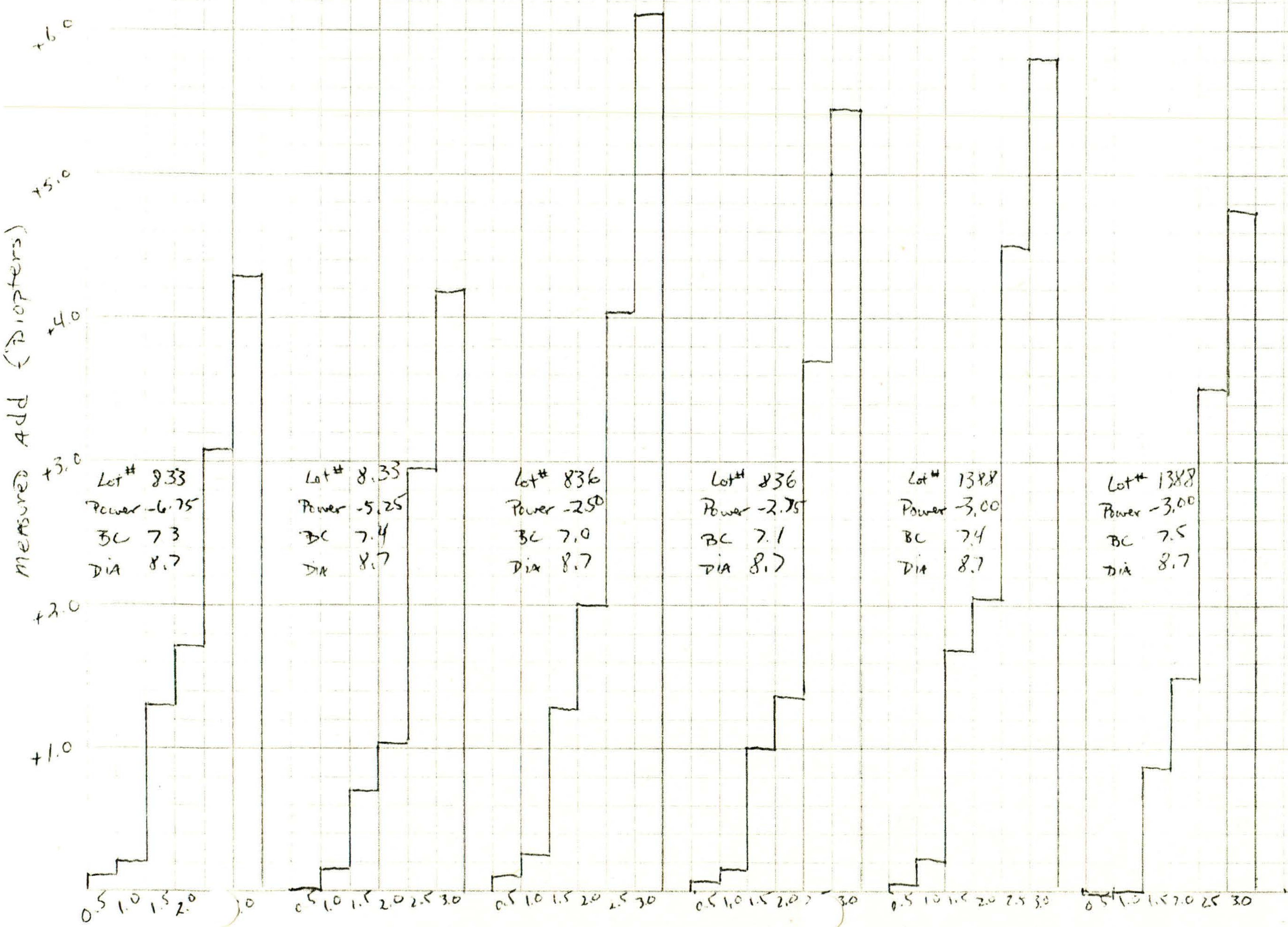

TABLE 1

	Distance From Center (mm)					
	0.5	1.0	1.5	2.0	2.5	3.0
AVERAGE	+0.41D	+0.36D	+1.05D	+1.60D	+2.87D	+3.86D
Range	-0.41 to +1.00 D	-0.33 to +2.30D	0.0 to +2.86D	+0.47 to +3.20D	+1.40 to +5.18D	+2.03 to +6.33D
Standard Deviation	±0.25D	±0.43D	±0.48D	±0.60D	±0.90D	±1.28D

Graph No. 2

AVERAGE ADD AND STANDARD DEVIATION AT EACH DISTANCE FROM CENTER.

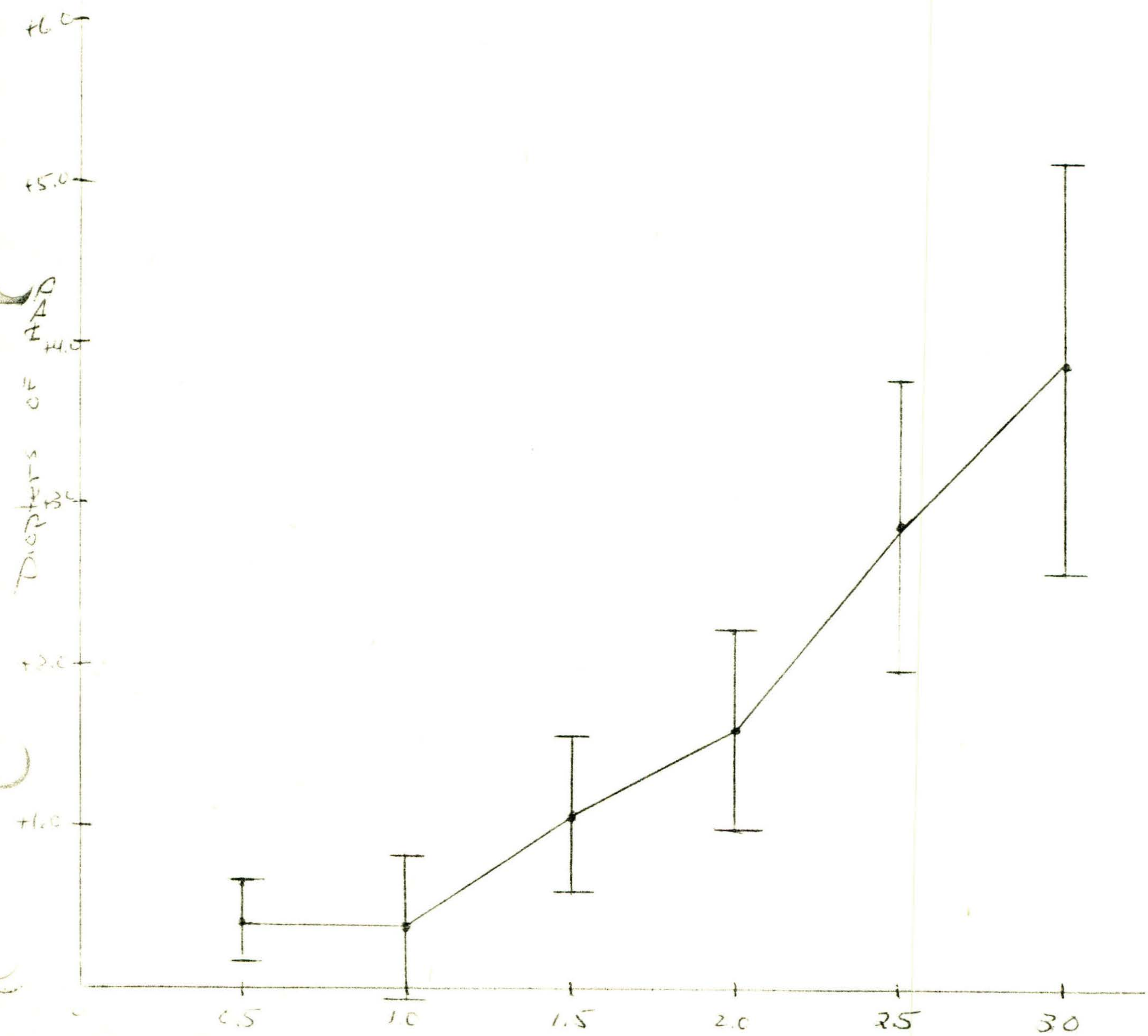

TABLE #2

Lot #	Apex Power (D)	Add @ 1mm (D)	Add @ 1.5 (D)	Add @ 2.0mm (D)	Dist. VA @ Dispense.	Near VA @ Dispense.
1155	-0.50	+0.38	+1.10	+1.85	20/15	20/15
1155	-0.50	+0.45	+0.95	+1.50	20/15	20/20
302	-0.75	-0.02	+0.50	+0.63	20/25	20/25
302	-1.00	+0.12	+0.58	+0.85	20/20	20/20
837	-1.00	+0.54	+0.70	+1.28	20/15	20/15
837	-1.00	+0.45	+0.62	+0.91	20/15	20/15
304	-1.00	+0.50	+0.80	+1.79	20/15	20/30^{-3}
296	-1.00	+0.74	+1.81	+2.69	20/20	NA
1387	-2.00	+0.08	+0.58	+0.87	20/25	20/20
1387	-2.00	+0.21	+2.02	+2.86	20/20^{-1}	20/20
304	-2.00	+0.85	+1.01	+1.55	20/40	20/20^{-3}
830	-2.00	+0.60	+0.68	+1.18	NA	NA
295	-2.00	+0.17	+1.28	+1.96	NA	NA
295	-2.25	+0.08	+1.25	+1.96	NA	NA
296	-2.25	+2.30	+2.86	+3.20	20/15	NA
836	-2.50	+0.23	+1.29	+1.99	20/25	20/15
293	-2.50	+1.28	+2.07	+2.30	20/20	20/50
836	-2.75	+0.14	+1.00	+1.38	20/20	20/15
1388	-3.00	+0.21	+1.68	+2.04	20/40	20/15
1388	-3.00	-0.02	+0.86	+1.48	20/30	20/15
293	-3.00	+0.10	+1.17	+1.90	20/20	20/30
830	-3.00	+0.43	+0.80	+1.05	NA	NA
297	-4.00	+0.29	+1.46	+1.93	20/15	20/15
297	-4.50	-0.23	+0.72	+0.95	20/15	20/15
829	-5.25	+0.21	+1.00	+1.64	20/15	20/15
829	-5.25	+0.04	+1.23	+1.49	20/20	20/15
833	-5.25	+0.17	+0.71	+1.02	NA	NA
294	-5.25	-0.04	+0.75	+1.44	20/20	20/20
294	-5.75	-0.33	+0.09	+0.47	20/20	20/20
833	-6.75	+0.19	+1.33	+1.73	NA	NA
838	+0.75	+0.63	+1.20	+1.82	20/20	20/15
838	+0.75	+0.50	+1.12	+1.75	20/20	20/15
1154	+4.25	+0.46	+0.75	+1.36	20/30^{-1}	20/20
1154	+4.50	+0.71	0.00	+1.45	20/25^{-1}	20/25

NA: NOT