CONFIDENTIAL

99 7065

,CORNING GLASS WORKS

ELECTRO-OPTICS LABORATORY

RALEIGH, NORTH CAROLINA

IMPROVED SCREEN FOR REAR PROJECTION VIEWERS

Technical Report No. - 16
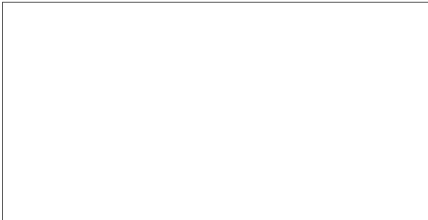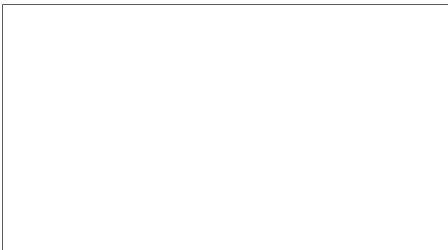
Date - December 12, 1966

Period Covered - November 14, 1966

to

December 12, 1966

EXCLUDED FROM AUTOMATIC
REGRADING; DOD DIR 5200.10
DOES NOT APPLY

25X1

CONFIDENTIAL

CONFIDENTIAL

ABSTRACT

This report summarizes the light scattering properties of many more Corning Glass Works' materials. Of the 65 samples measured, 5 were found which have sufficiently good optical properties to warrant further investigations.

Prototype rear projection screens measuring 3" x 3" have been fabricated from Fotoform® glass. Work is continuing on lenticular Fotoform® glass and glasses with metallic particles.

CONFIDENTIAL

CONFIDENTIAL

TECHNICAL REPORT NO. 16

I. Materials

A. Glass Ceramics

Since the last reporting period we have measured an additional 65
samples of glass-ceramic materials of which some 5 different samples
look promising. These samples are AU-3A, AU-4A, and AU-6A, and
particularly AS-4A and AS-9A. The first group, the AU series, have
particle concentrations somewhat greater than optimum making them less
efficient; however, the scattering appears to be nearly independent
of wavelength which is very desirable. Remelts of the AU series with
lower particle concentrations have been requested, as well as electron
micrographs of AS-4 and AS-9. The remainder of the samples are not
suitable because of their specular transmission in the red.

The optical data from all 65 samples are summarized in the data
appendix beginning with Tables A-1 & A-2. Curves for T_{45} data vs.
axial gain are given in Figures A-1 and A-2 and the Gain (θ) curves
along with tabular values of Gain (θ) follow. It should be noted that
included with the compressed data is the brightness variation of each
sample within $\pm 45^{\circ}$, denoted by V_{45}.

New samples of the same glasses AC-18 and AC-19 are designated AP and
AR, respectively. We have found that the AP and AR series are less
satisfactory than the AC-18 and AC-19 samples because there is considerable
specular transmission at the longer wavelengths. This seems to be
because of the smaller particle size. Electron micrographs of these
new samples are being prepared to establish this. Figure A-3 shows the
scattering particles in sample AC-19. The white bar represents 1 micron.
Clearly the average particle size is about .3 to .4 micron, exactly the
optimum size for the required uniformity.

As before most of the glass ceramics have predictable values of T_{45}. In
every case where a sample has a much less than optimum value of T_{45}, Figures
A-1 and A-2, the particle concentration is too low and a large fraction of
the incident light is specularly transmitted. The high gains reported are
due to interference from the specularly transmitted light, and not due to
absorption or multiple scattering as with the commercial rear projection

CONFIDENTIAL

screen materials. This stray light also has the effect of causing the brightness variation to appear very large.

Several techniques of making thin layers of glass-ceramic material are presently being investigated. Some of these techniques will be used to make 12" x 12" prototype rear projection screens for detailed visual evaluation.

B. Fotoform® Glass

Investigations of the optical properties of this material are continuing; however, some time delays have occurred because of difficulties with an oven used for heat treating the glass. Three prototype rear projection screens of this material measuring 3 inches square have been fabricated. These are being ground and polished and will be forwarded for further evaluation along with a data sheet of their optical properties within the next two weeks.

The Ronchi ruling for making the lenticular samples has been made and samples of this material will be fabricated as soon as repairs on the oven are complete.

C. Metallic Particles

Work in this area is continuing; however, it has been quite difficult to obtain sufficiently large metallic particles.

D. Materials Comparisons

We are fabricating a mosiac to hold about 8 commercial rear projection screen materials and 6 to 8 Corning Glass Works' materials. This will be used for visually comparing different materials. It will be constructed so as to duplicate an actual projection system.

II. Instrumentation

All electrical and mechanical parts of the modulation transfer function analyzer are complete. Special sine-wave resolution targets are being made and the complete system with the new masks will be available by the end of December .

CONFIDENTIAL

Table A-1

Summary of the Optical Properties of
Some Corning Glass Works' Materials

Sample Code	T_s %	T_{45} %	T_{spec} %	Axial Gain	Brightness Variation $\pm 45^{\circ}$ (%)	Thickness (mm)
AH-2A	50.	18.	0.0	1.3	3.2	0.965
AH-2D	50.	18.	0.0	1.4	7.2	0.991
AJ-1A	33.	12.	0.0	0.9	4.6	0.585
AJ-1B	18.	6.3	0.0	0.4	16.	1.119
AJ-3A	63.	46.	35.	56.	97.	0.356
AJ-4A	93.	43.	1.	6.	49.	0.483
AJ-4B	58.	23.	0.1	1.8	11.	0.016
AJ-5A	56.	22.	0.1	1.6	7.2	0.559
AJ-5B	35.	12.	0.0	0.9	5.3	1.016
AJ-6A	51.	18.	0.4	1.3	3.9	0.483
AJ-6B	32.	12.	0.3	0.8	2.3	0.864
AP-1A	82.	31.	1.5	2.1	1.6	0.508
AP-1B	72.	27.	0.1	1.9	3.7	1.091
AP-2A	92.	42.	7.4	7.7	56.	0.508
AP-2B	71.	27.	0.1	1.9	3.8	1.029
AP-3A	77.	29.	1.5	2.0	2.1	0.508
AP-3B	75.	28.	0.1	2.0	2.8	0.991
AP-4A	77.	29.	1.5	2.0	3.9	0.508
AP-4B	72.	27.	0.1	1.9	3.9	1.003
AP-5A	81.	30.	1.5	2.2	4.1	0.508
AP-5B	66.	24.	0.1	1.7	3.0	1.011
AR-1A	78.	29.	0.1	2.1	4.1	0.547
AR-1B	66.	25.	0.1	1.8	4.5	1.119
AR-2A	78.	29.	0.5	2.1	5.5	0.521
AR-2B	61.	22.	0.1	1.6	2.1	1.091
AR-3A	80.	30.	0.1	2.2	4.0	0.521
AR-3B	69.	26.	0.1	1.8	3.3	1.119
AR-4A	79.	29.	0.5	2.1	4.1	0.496
AR-4B	60.	23.	0.1	1.6	4.2	1.105
AR-5A	73.	28.	2.5	2.1	6.1	0.483
AR-5B	54.	20.	0.2	1.5	3.4	1.091

CONFIDENTIAL

Table A-1 Continued

| Sample Code	T_s %	T_{45} %	T_{spec} %	Axial Gain	Brightness Variation $\pm 45^o$ (%)	Thickness (mm)
AS-1A	90.	42.	1.9	7.5	57.	0.33
AS-1B	75.	30.	1.4	2.6	15.	1.016
AS-2A	82.	40.	7.7	16.	80.	0.33
AS-2B	75.	31.	2.3	2.8	21.	1.003
AS-3A	73.	46.	23.	12.	80.	0.33
AS-3B	86.	42.	6.6	5.2	43.	0.991
AS-4A	78.	29.	1.2	2.2	7.5	0.33
AS-4B	47.	20.	0.8	1.4	2.5	0.991
AS-5A	73.	52.	20.	29.	93.	0.33
AS-5B	86.	52.	8.2	8.8	66.	0.991
AS-6A	69.	25.	1.8	1.9	5.7	0.33
AS-6B	34.	14.	0.5	1.0	2.4	0.991
AS-7A	87.	42.	2.8	5.4	46.	0.336
AS-7B	77.	32.	1.5	2.5	12.	0.991
AS-8A	83.	37.	5.3	5.9	52.	0.33
AS-8B	68.	27.	1.4	2.2	11.	0.986
AS-9A	76.	30.	2.3	2.2	6.7	0.33
AS-9B	49.	19.	0.8	1.3	3.8	0.965
AS-10A	87.	44.	6.7	10.	68.	0.33
AS-10B	78.	31.	1.7	2.5	13.	0.978
AS-11A	80.	41.	11.	7.0	60.	0.33
AS-11B	80.	33.	1.7	2.6	12.	0.991
AU-1A	49.	19.	0.1	1.4	6.2	0.559
AU-1B	26.	9.6	0.4	0.7	2.5	1.091
AU-2A	47.	18.	0.1	1.3	2.8	0.585
AU-2B	23.	9.0	0.4	0.6	3.0	1.091
AU-3A	59.	22.	0.1	1.6	3.3	0.597
AU-3B	44.	17.	0.6	1.5	15.	1.068
AU-4A	59.	22.	0.1	1.6	2.5	0.33
AU-4B	21.	8.3	0.4	0.6	2.6	0.965
AU-5A	46.	17.	0.1	1.2	2.5	0.559
AU-5B	21.	8.1	0.3	0.6	2.6	1.068
AU-6A	52.	19.	0.1	1.3	2.2	0.559
AU-6B	26.	11.	0.4	0.8	3.5	1.052

Figure A-1. The Fraction of Incident Power Scattered Into $\pm 45^{\circ}$ by Corning Materials as a Function of Axial Gain.
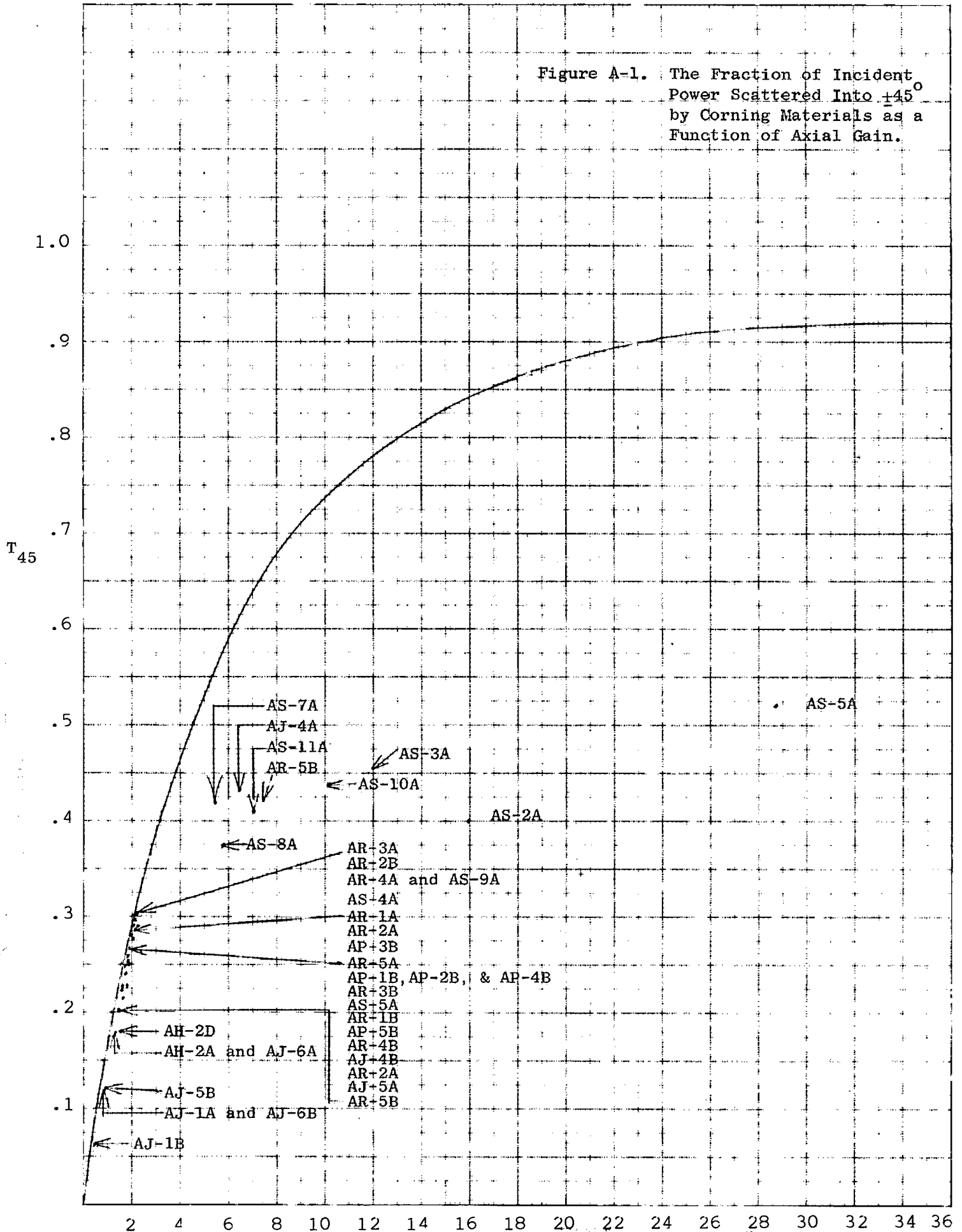
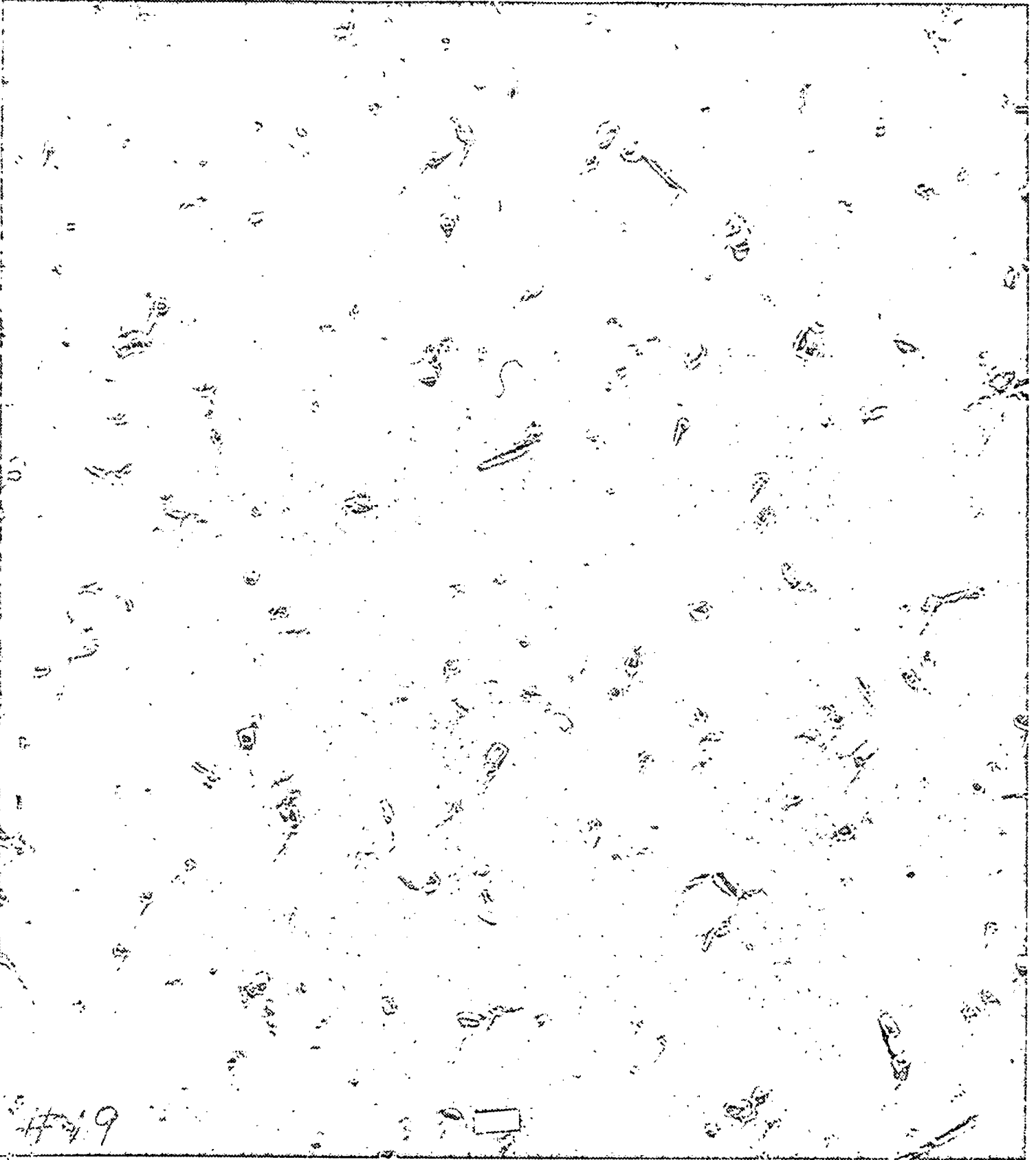Figure A-2. The Fraction of Incident Power Scattered Into ±45° by Corning Materials as a Function of Axial Gain.
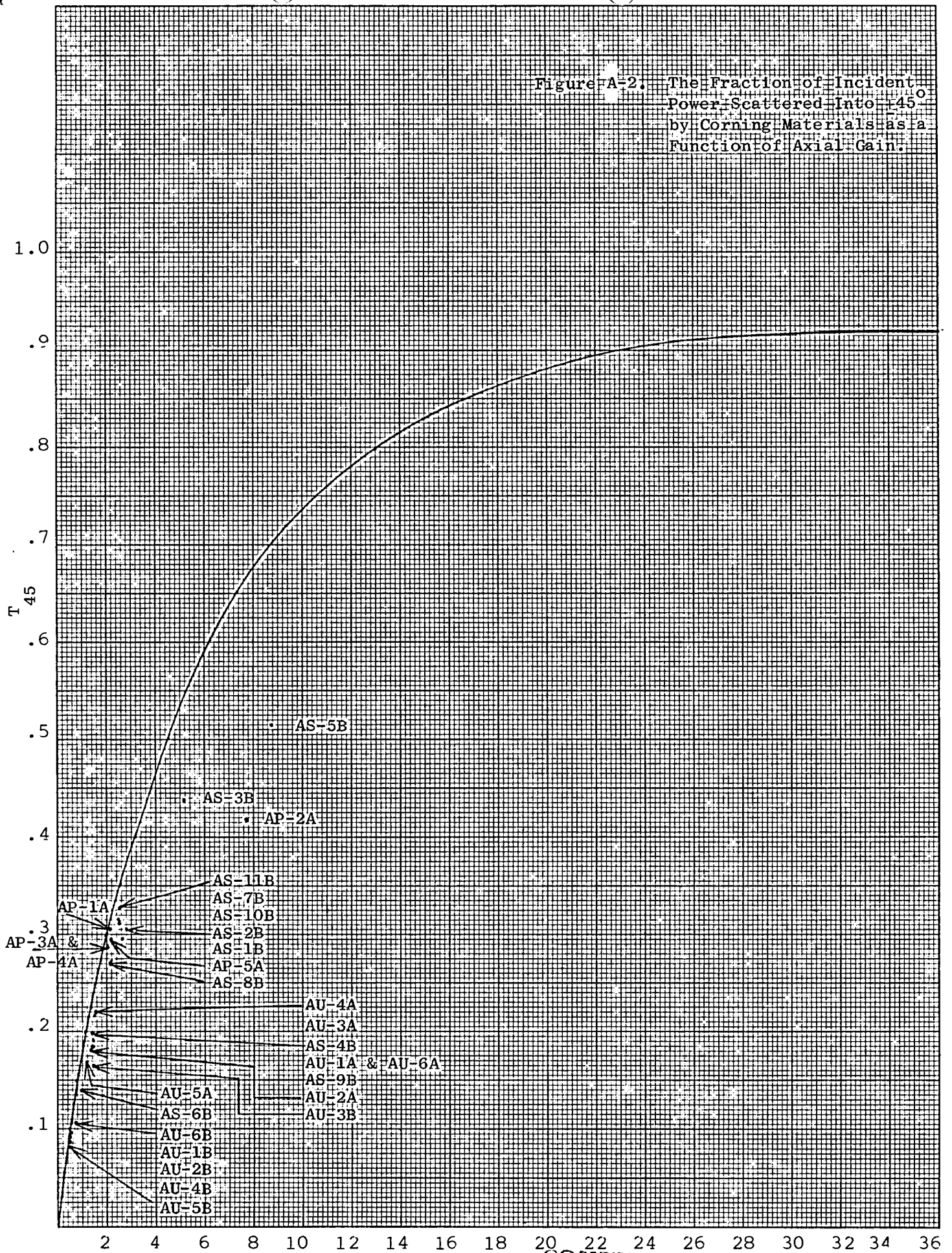
Figure A-3. Electron Micrograph of Sample AC-19.
Length of White Bar is 1 Micron.

CONFIDENTIAL
Table A-2

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	SAMPLE CODES					
	AH-2A	AH-2D	AJ-1A	AJ-1B	AJ-3A	AJ-4A
0	1.273	1.368	.860	.438	55.787	6.456
5	1.256	1.314	.847	.438	19.558	4.842
10	1.249	1.284	.841	.438	8.072	4.269
15	1.236	1.265	.839	.438	5.578	3.826
20	1.230	1.258	.834	.438	4.233	3.462
25	1.224	1.251	.826	.437	3.150	3.150
30	1.218	1.239	.818	.435	2.297	2.863
35	1.211	1.225	.808	.433	1.607	2.629
40	1.205	1.206	.795	.430	1.247	2.421
45	1.193	1.183	.783	.425	.918	2.238
50	1.177	1.162	.770	.419	.754	2.082
55	1.160	1.135	.753	.411	.656	1.926
60	1.131	1.108	.734	.400	.590	1.785
65	1.088	1.080	.709	.384	.525	1.645
70	1.026	1.046	.675	.356	.459	1.509
75	.939	.964	.624	.318	.426	1.327
80	.779	.827	.550	.269	.380	1.067
85	.494	.410	.378	.198	.196	.702
90	.000	.000	.000	.000	.000	.000
=========	=====	=====	=====	=====	=====	=====
TS	.500	.500	.334	.177	.627	.934
T45	.178	.180	.119	.063	.459	.434
TSP	.0000	.0000	.0000	.0000	.348	.0087
V45	.032	.072	.046	.159	.967	.485
ABS						

CONFIDENTIAL

AH-2A
AH-2D
AJ-1A
AJ-1B
AJ-3A
AJ-4A

Gain (K)

46 5810   MADE IN U.S.A.
SEMI-LOGARITHMIC
3 CYCLES X 140 DIVISIONS
KEUFFEL & ESSER CO.
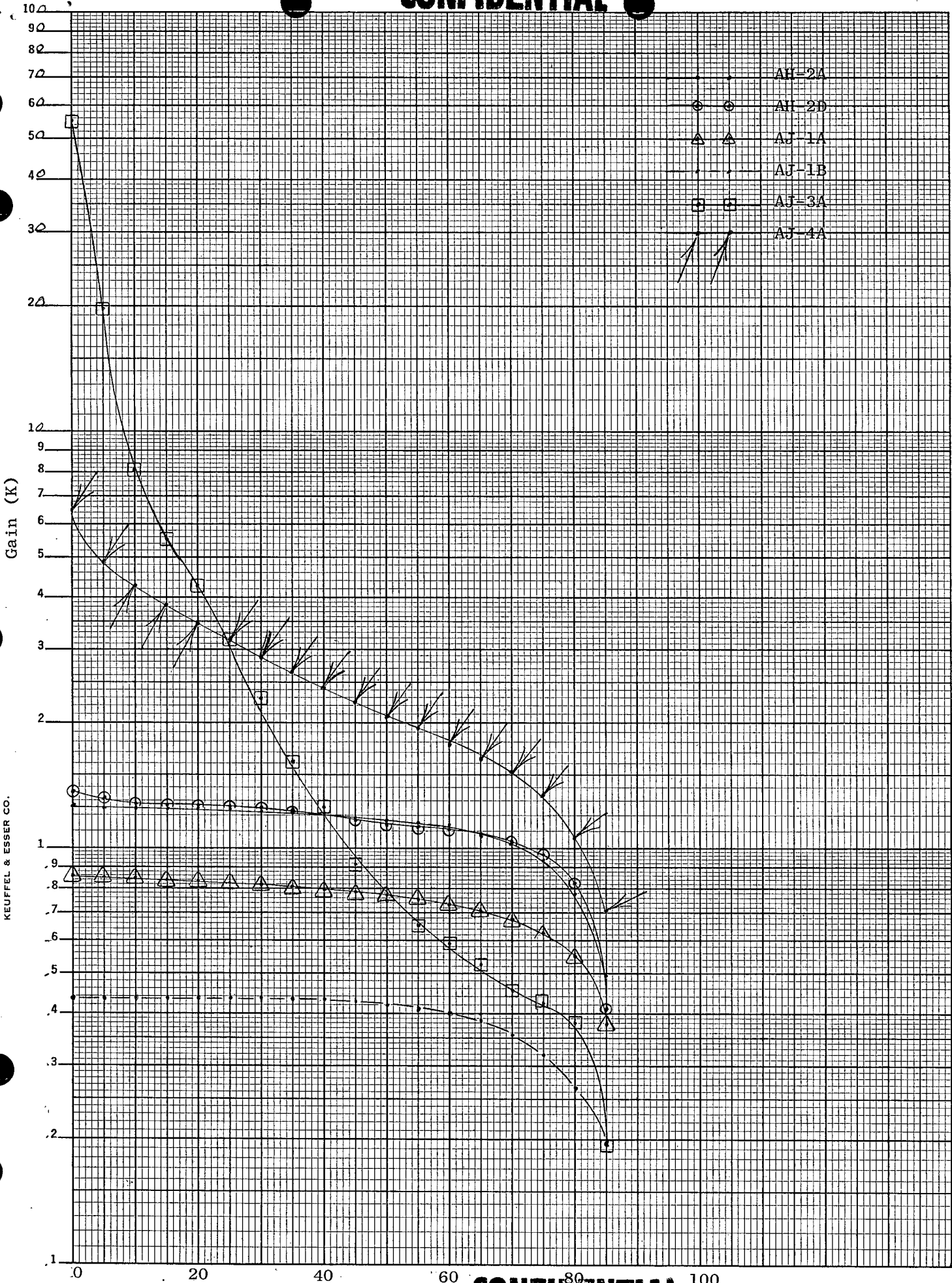
CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AJ-4B	AJ-5A	SAMPLE CODES AJ-5B	AJ-6A	AJ-6B	
0	1.810	1.633	.918	1.307	.819	.000
5	1.701	1.551	.895	1.294	.817	.000
10	1.665	1.519	.879	1.281	.815	.000
15	1.647	1.502	.866	1.268	.815	.000
20	1.629	1.502	.856	1.243	.813	.000
25	1.598	1.502	.848	1.223	.811	.000
30	1.566	1.486	.845	1.217	.807	.000
35	1.520	1.465	.838	1.214	.799	.000
40	1.475	1.437	.829	1.211	.791	.000
45	1.444	1.411	.824	1.208	.781	.000
50	1.408	1.388	.813	1.202	.767	.000
55	1.367	1.368	.802	1.191	.747	.000
60	1.321	1.352	.786	1.178	.723	.000
65	1.240	1.333	.762	1.159	.703	.000
70	1.122	1.233	.729	1.090	.639	.000
75	.963	1.037	.577	.967	.543	.000
80	.742	.669	.570	.807	.431	.000
85	.362	.098	.365	.435	.239	.000
90	.000	.000	.000	.000	.000	.000

===

	AJ-4B	AJ-5A	AJ-5B	AJ-6A	AJ-6B	
TS	.578	.564	.351	.510	.315	.000
T45	.227	.215	.123	.173	.117	.000
TSP	.0011	.0010	.0000	.0044	.0029	
V45	.112	.072	.053	.039	.023	
ABS						

CONFIDENTIAL
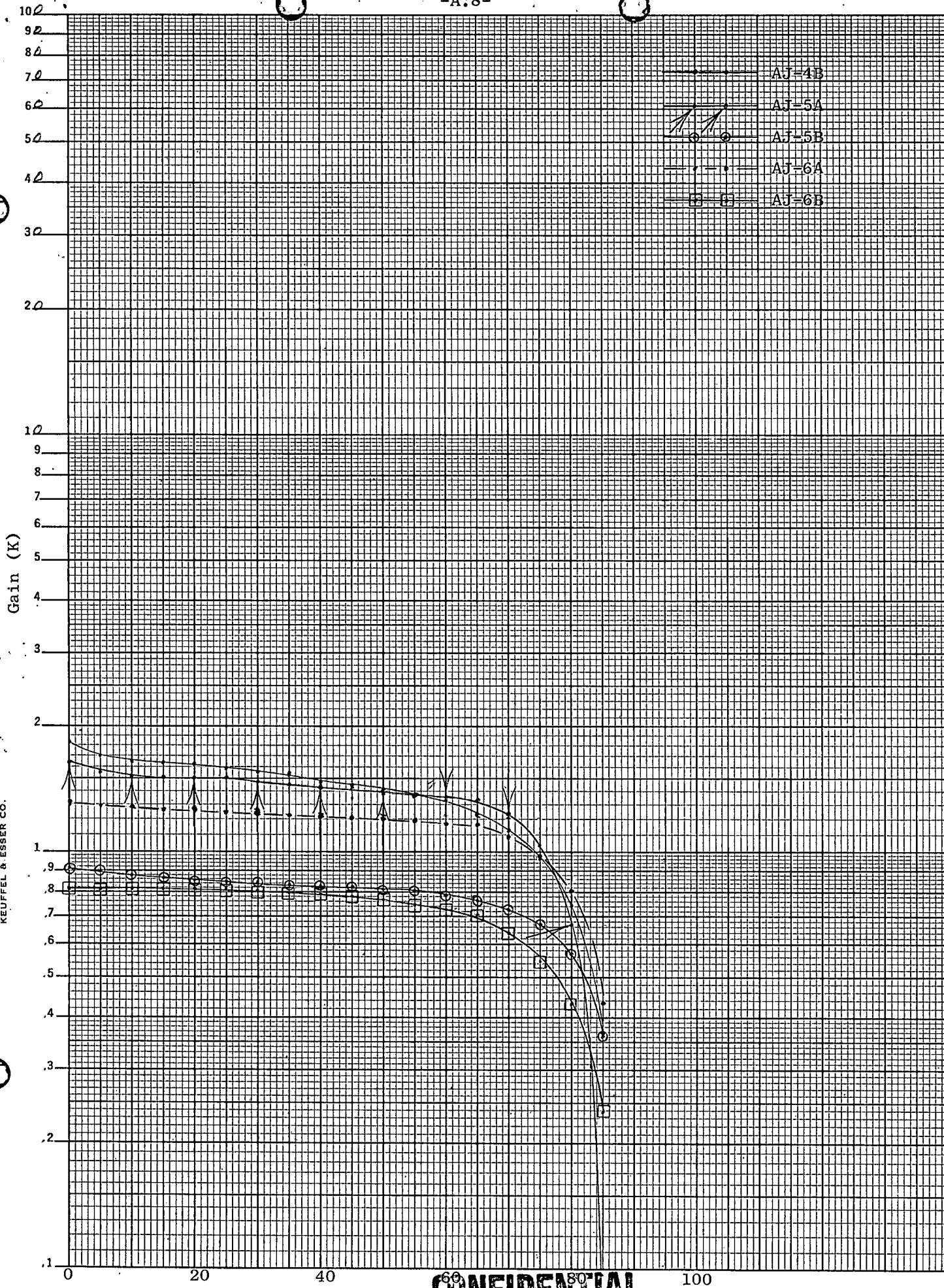
-A.8-

Legend:
- AJ-4B
- AJ-5A
- AJ-5B
- AJ-6A
- AJ-6B

Gain (K)

46 5810 MADE IN U.S.A.
K+E SEMI-LOGARITHMIC 3 CYCLES X 140 DIVISIONS
KEUFFEL & ESSER CO.

CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AP-1A	AP-2A	SAMPLE CODES AP-3A	AP-4A	AP-5A	
0	2.132	7.694	2.004	2.033	2.152	.000
5	2.132	5.974	2.004	2.027	2.119	.000
10	2.132	4.616	2.004	2.023	2.086	.000
15	2.132	3.801	2.004	2.012	2.073	.000
20	2.132	3.213	2.004	2.002	2.053	.000
25	2.120	2.941	1.993	1.991	2.041	.000
30	2.109	2.579	1.983	1.971	2.030	.000
35	2.097	2.443	1.972	1.940	2.019	.000
40	2.086	2.308	1.940	1.908	1.997	.000
45	2.063	2.172	1.919	1.877	1.982	.000
50	2.017	2.036	1.876	1.836	1.953	.000
55	1.971	1.900	1.823	1.805	1.919	.000
60	1.903	1.787	1.748	1.763	1.853	.000
65	1.811	1.706	1.673	1.701	1.775	.000
70	1.662	1.538	1.567	1.618	1.642	.000
75	1.467	1.403	1.428	1.431	1.509	.000
80	1.192	1.086	1.066	1.126	1.165	.000
85	.492	.543	.511	.477	.554	.000
90	.000	.000	.000	.000	.000	.000

===

TS	.824	.915	.771	.771	.806	.000
T45	.308	.418	.288	.286	.297	.000
TSP	.0149	.0744	.0149	.0149	.0151	
V45	.016	.559	.021	.039	.041	
ABS						

CONFIDENTIAL
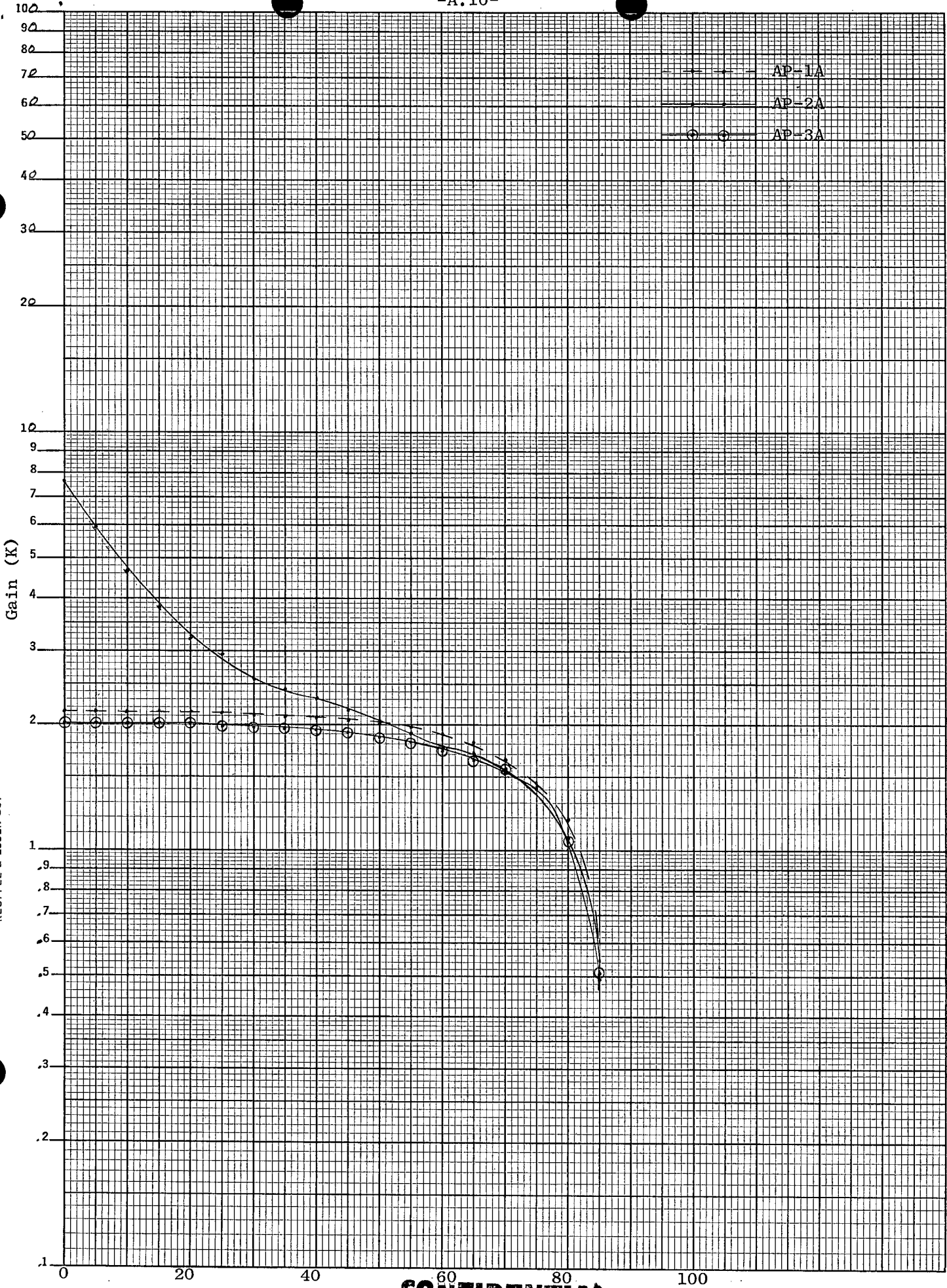
CONFIDENTIAL

-A.10-

CONFIDENTIAL

Legend:
- — · — · — AP-1A
- ———————— AP-2A
- —⊙——⊙— AP-3A

Gain (K)

46 5810 MADE IN U.S.A.

SEMI-LOGARITHMIC
3 CYCLES X 140 DIVISIONS
KEUFFEL & ESSER CO.
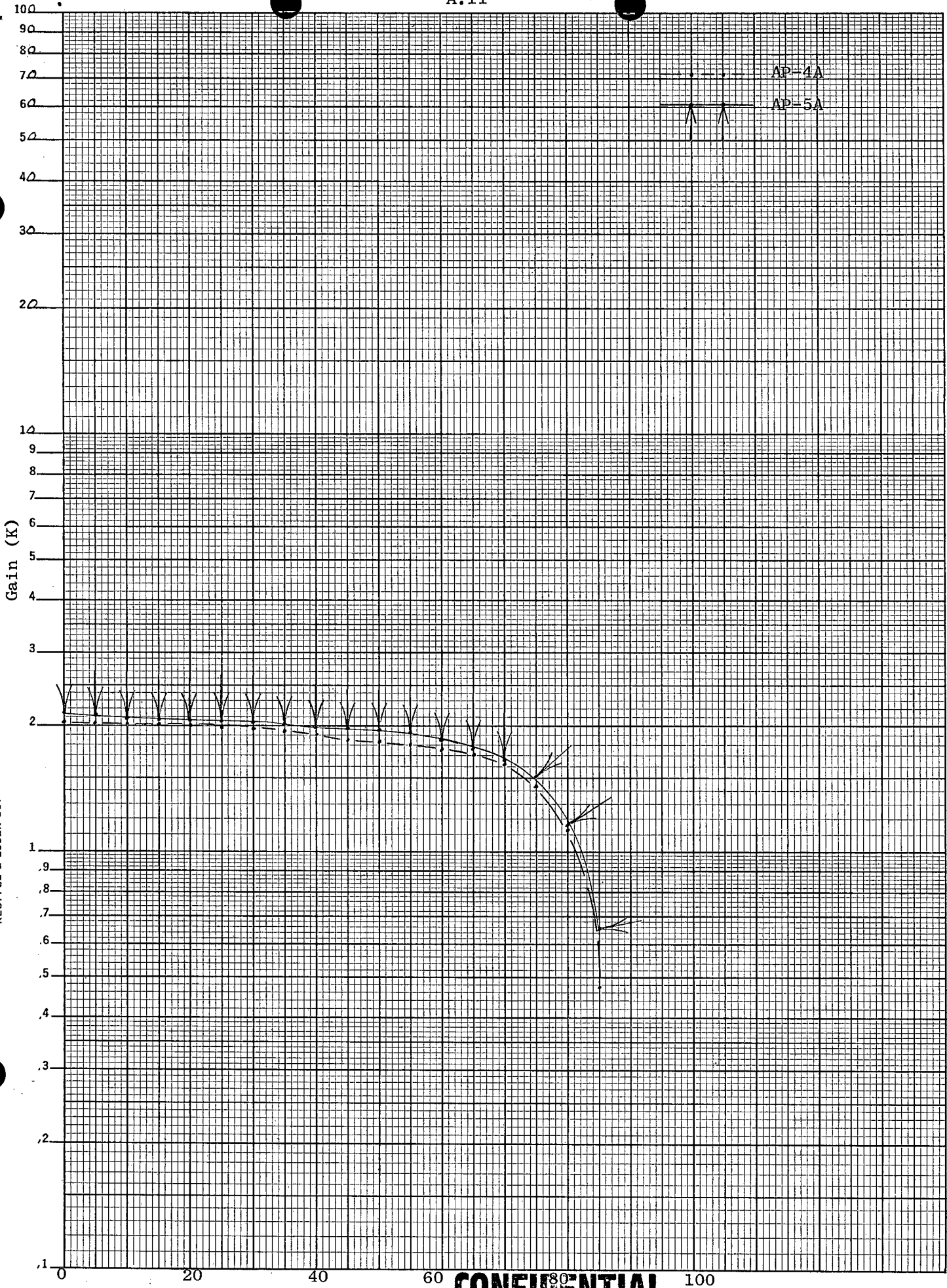
CONFIDENTIAL

CONFIDENTIAL

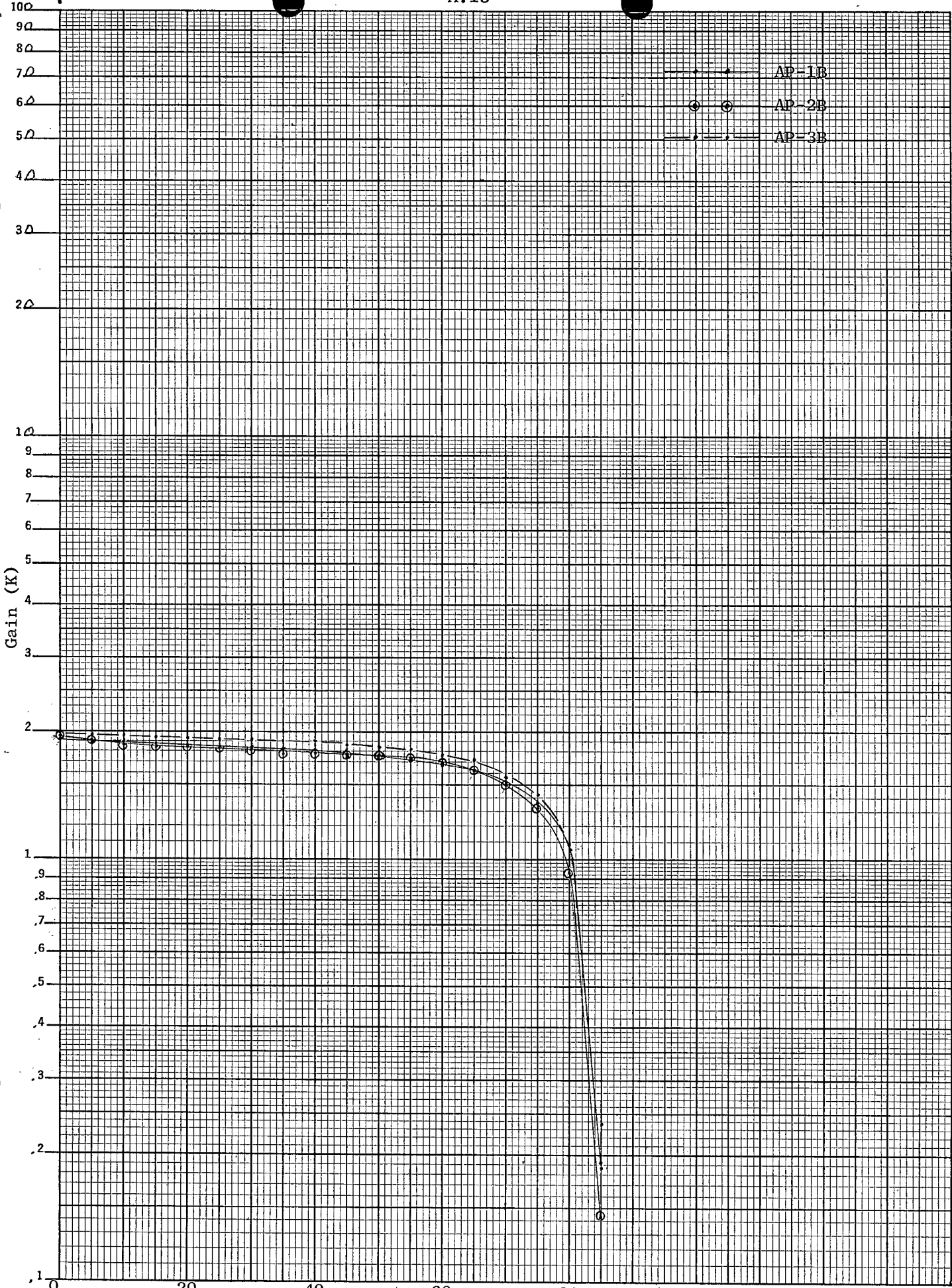## SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AP-1B	AP-2B	AP-3B	AP-4B	AP-5B	
0	1.911	1.929	1.995	1.944	1.712	.000
5	1.911	1.893	1.977	1.926	1.712	.000
10	1.894	1.875	1.958	1.908	1.712	.000
15	1.876	1.857	1.939	1.889	1.695	.000
20	1.859	1.857	1.920	1.889	1.678	.000
25	1.842	1.839	1.920	1.871	1.678	.000
30	1.842	1.839	1.920	1.871	1.678	.000
35	1.824	1.822	1.901	1.853	1.644	.000
40	1.807	1.786	1.901	1.816	1.627	.000
45	1.772	1.786	1.883	1.798	1.610	.000
50	1.737	1.750	1.845	1.779	1.576	.000
55	1.703	1.714	1.807	1.742	1.559	.000
60	1.668	1.697	1.770	1.669	1.509	.000
65	1.616	1.607	1.713	1.614	1.441	.000
70	1.511	1.500	1.581	1.541	1.339	.000
75	1.372	1.321	1.412	1.357	1.203	.000
80	1.094	.928	1.073	1.045	.966	.000
85	.191	.142	.188	.238	.474	.000
90	.000	.000	.000	.000	.000	.000

==

	AP-1B	AP-2B	AP-3B	AP-4B	AP-5B	
TS	.716	.705	.748	.723	.658	.000
T45	.268	.267	.280	.271	.242	.000
TSP	.0011	.0011	.0011	.0011	.0009	
V45	.037	.038	.028	.039	.030	
ABS						

CONFIDENTIAL

CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AR-1A	AR-1B	SAMPLE CODES AR-2A	AR-2B	AR-3A	AR-3B
0	2.087	1.825	2.120	1.574	2.165	1.821
5	2.087	1.807	2.090	1.558	2.141	1.838
10	2.087	1.754	2.059	1.558	2.141	1.838
15	2.076	1.737	2.018	1.558	2.117	1.821
20	2.065	1.737	2.018	1.558	2.117	1.821
25	2.021	1.737	1.998	1.541	2.117	1.787
30	1.999	1.702	1.977	1.541	2.070	1.787
35	1.955	1.684	1.957	1.525	2.046	1.787
40	1.933	1.684	1.937	1.525	2.046	1.737
45	1.922	1.667	1.896	1.508	1.998	1.720
50	1.933	1.614	1.896	1.508	1.951	1.686
55	1.845	1.597	1.814	1.491	1.903	1.636
60	1.801	1.526	1.774	1.409	1.856	1.585
65	1.691	1.491	1.712	1.359	1.760	1.501
70	1.559	1.403	1.549	1.259	1.641	1.399
75	1.406	1.228	1.386	1.160	1.403	1.281
80	1.109	.947	1.121	.895	1.094	1.011
85	.571	.122	.611	.232	.523	.337
90	.000	.000	.000	.000	.000	.000
=================						
TS	.782	.658	.778	.608	.803	.690
T45	.291	.250	.289	.224	.303	.260
TSP	.0013	.0011	.0049	.001	.0013	.0011
V45	.041	.045	.055	.021	.040	.033
ABS						

CONFIDENTIAL

-A.16-
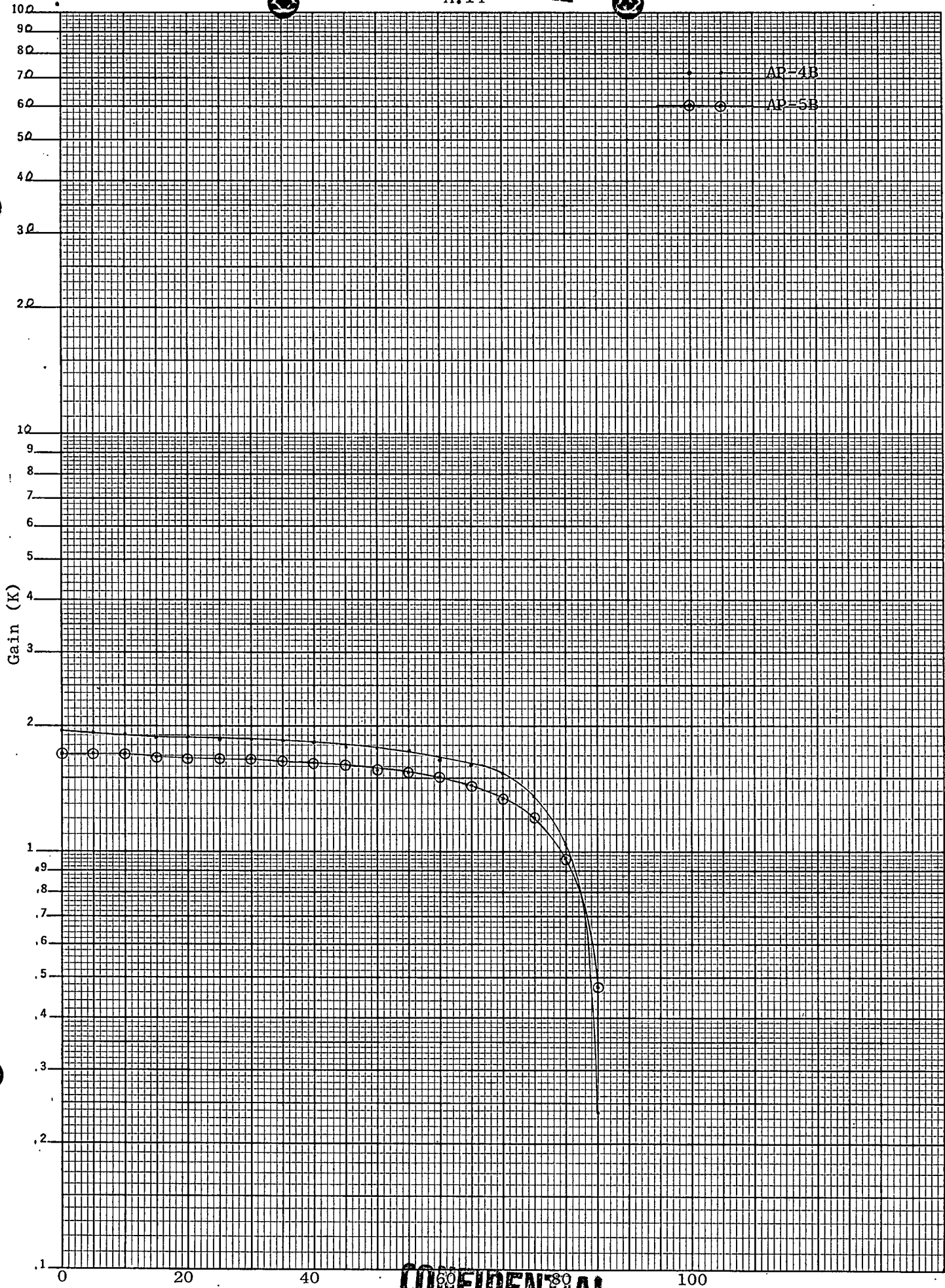
Legend:
- AR-1A
- AR-1B
- AR-2A
- AR-2B
- AR-3A
- AR-3B

Y-axis: Gain (K)

SEMI-LOGARITHMIC
3 CYCLES X 140 DIVISIONS
KEUFFEL & ESSER CO.
MADE IN U.S.A.
46 5810

-A.17-

CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AR-4A	AR-4B	SAMPLE CODES AR-5A	AR-5B		
0	2.105	1.624	2.050	1.450	.000	.000
5	2.084	1.624	2.023	1.450	.000	.000
10	2.063	1.609	1.997	1.450	.000	.000
15	2.063	1.594	1.984	1.437	.000	.000
20	2.063	1.565	1.971	1.409	.000	.000
25	2.042	1.565	1.918	1.395	.000	.000
30	2.021	1.594	1.892	1.367	.000	.000
35	1.979	1.565	1.866	1.367	.000	.000
40	1.958	1.491	1.839	1.353	.000	.000
45	1.937	1.506	1.813	1.353	.000	.000
50	1.916	1.491	1.787	1.325	.000	.000
55	1.895	1.476	1.708	1.311	.000	.000
60	1.810	1.387	1.682	1.255	.000	.000
65	1.705	1.328	1.550	1.241	.000	.000
70	1.600	1.269	1.445	1.116	.000	.000
75	1.389	1.151	1.261	.976	.000	.000
80	1.137	.767	.946	.795	.000	.000
85	.673	.088	.473	.251	.000	.000
90	.000	.000	.000	.000	.000	.000

==

	AR-4A	AR-4B	AR-5A	AR-5B		
TS	.793	.595	.725	.543	.000	.000
T45	.293	.227	.277	.202	.000	.000
TSP	.0053	.0011	.025	.002		
V45	.041	.042	.061	.034		
ABS						

CONFIDENTIAL
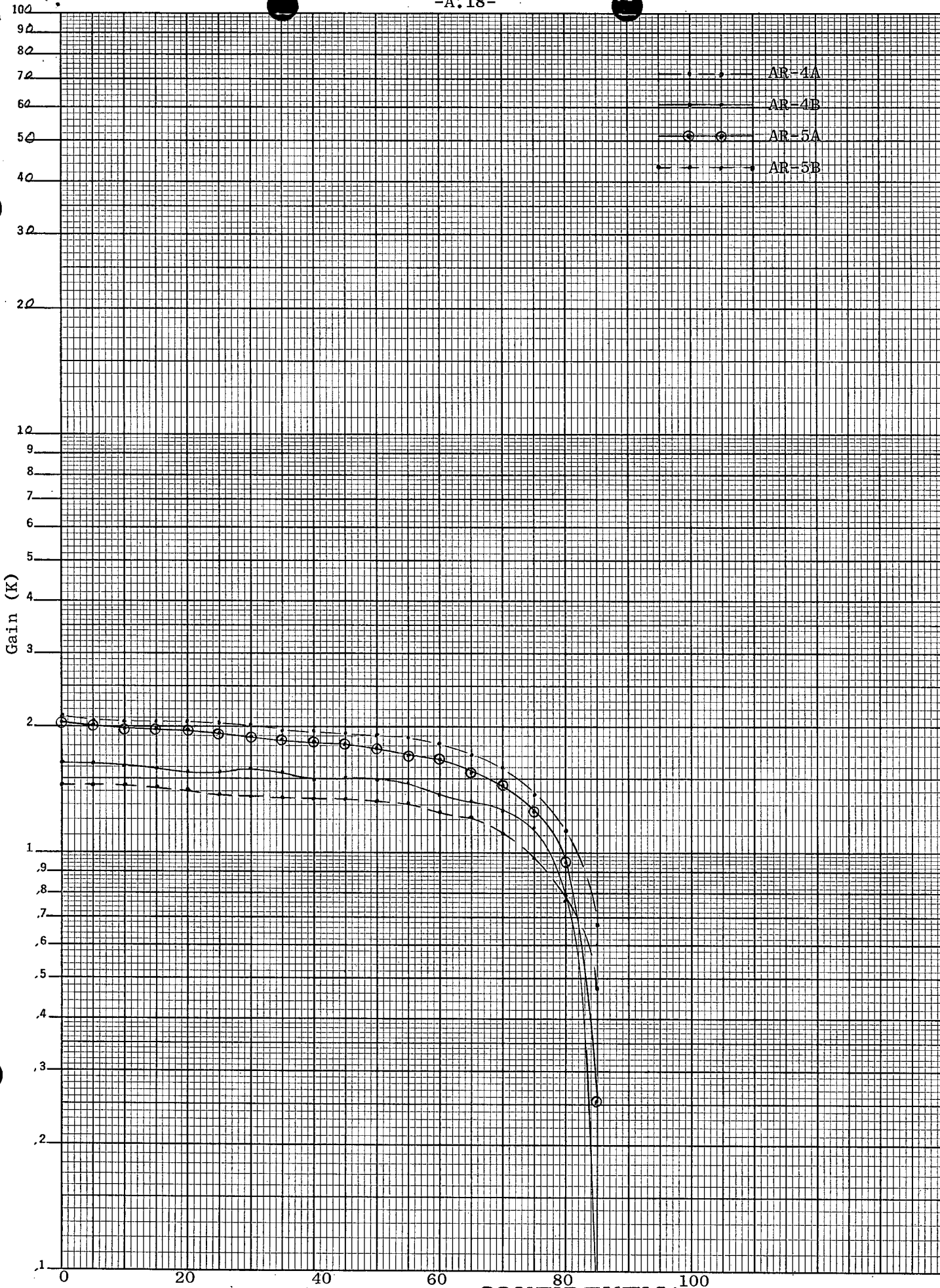
AR-4A

AR-4B

AR-5A

AR-5B

Gain (K)

SEMI-LOGARITHMIC
3 CYCLES X 140 DIVISIONS
KEUFFEL & ESSER CO.
46 5810
MADE IN U.S.A.

CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K			SAMPLE CODES			
	AS-1A	AS-2A	AS-3A	AS-4A	AS-5A	AS-6A
0	7.530	15.943	11.998	2.219	28.684	1.887
5	6.475	11.547	9.047	2.136	17.688	1.835
10	5.346	7.151	7.080	2.073	13.625	1.784
15	4.292	3.751	5.802	2.073	8.366	1.784
20	3.388	2.790	4.523	2.032	4.780	1.766
25	2.936	2.321	3.442	2.001	2.987	1.766
30	2.597	2.110	2.606	1.990	2.151	1.732
35	2.334	1.992	1.966	1.970	1.434	1.715
40	2.146	1.875	1.573	1.928	1.195	1.698
45	2.033	1.758	1.357	1.908	.956	1.681
50	1.942	1.699	1.180	1.866	.836	1.629
55	1.844	1.641	1.052	1.835	.764	1.612
60	1.731	1.582	.914	1.762	.717	1.543
65	1.656	1.524	.885	1.710	.645	1.475
70	1.581	1.406	.786	1.617	.597	1.372
75	1.430	1.207	.688	1.410	.525	1.269
80	1.069	.902	.590	1.119	.478	1.063
85	.338	.234	.393	.642	.358	.669
90	.000	.000	.000	.000	.000	.000

TS	.904	.820	.727	.784	.728	.693
T45	.424	.400	.455	.290	.522	.253
TSP	.019	.0772	.228	.0117	.202	.0178
V45	.574	.801	.796	.075	.935	.057
ABS						

CONFIDENTIAL
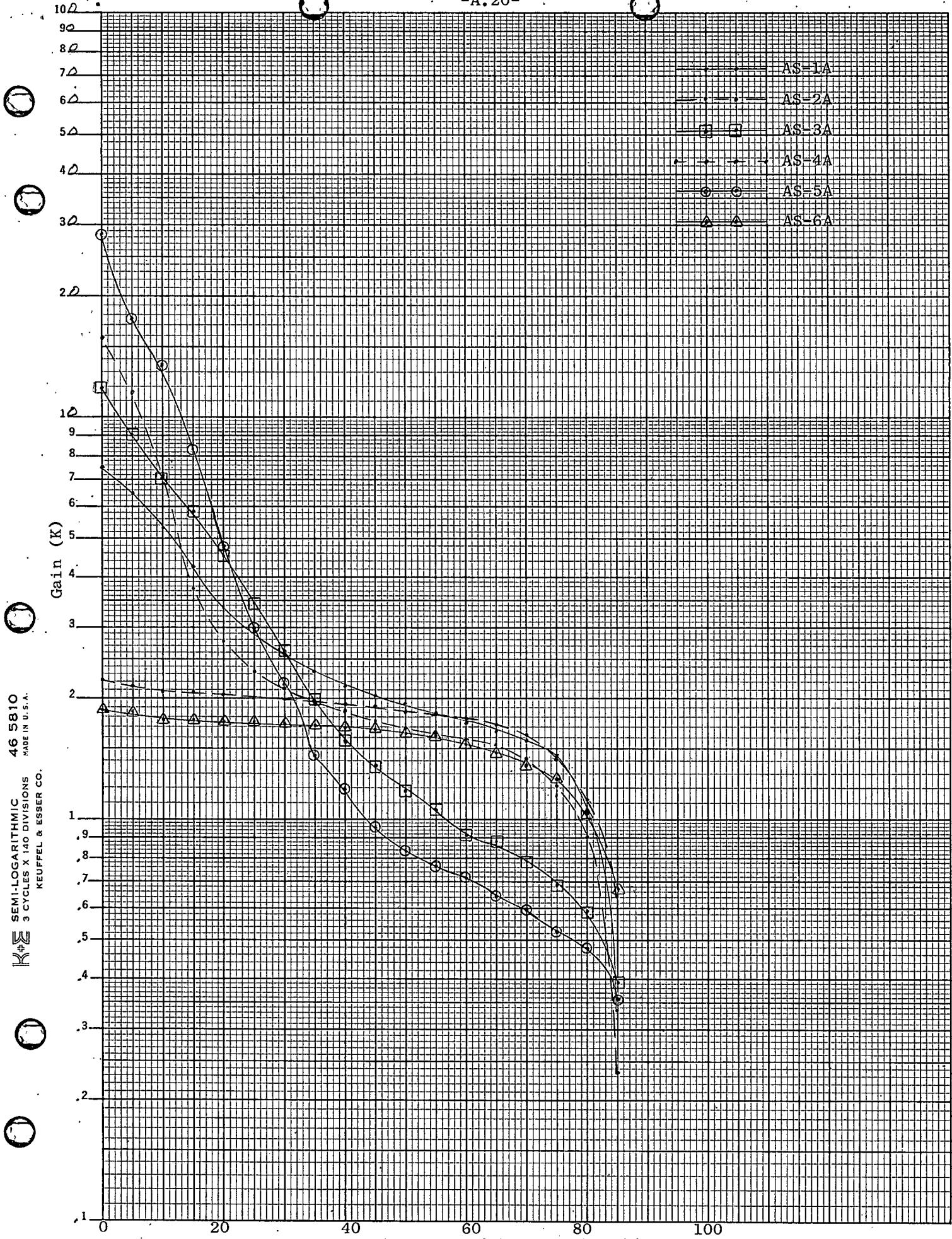
CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	SAMPLE CODES					
	AS-1B	AS-2B	AS-3B	AS-4B	AS-5B	AS-6B
0	2.618	2.830	5.192	1.396	8.781	.957
5	2.291	2.802	4.743	1.396	8.396	.952
10	2.160	2.581	4.436	1.396	7.368	.948
15	2.138	2.354	4.106	1.393	6.040	.947
20	2.094	2.213	3.681	1.382	4.883	.944
25	2.051	2.129	3.280	1.375	3.812	.938
30	2.007	2.073	2.926	1.368	3.084	.932
35	1.985	1.989	2.596	1.358	2.484	.928
40	1.942	1.905	2.312	1.346	2.099	.920
45	1.920	1.863	2.053	1.326	1.799	.911
50	1.887	1.793	1.864	1.305	1.567	.899
55	1.854	1.737	1.675	1.267	1.379	.878
60	1.789	1.667	1.543	1.214	1.242	.847
65	1.723	1.569	1.416	1.145	1.113	.802
70	1.592	1.429	1.250	1.012	.976	.730
75	1.331	1.261	1.085	.656	.848	.541
80	.741	.952	.826	.125	.685	.251
85	.120	.420	.377	.000	.359	.000
90	.000	.000	.000	.000	.000	.000

===

TS	.749	.753	.856	.474	.856	.339
T45	.295	.306	.438	.199	.515	.136
TSP	.0138	.0228	.066	.0081	.0824	.0053
V45	.153	.206	.433	.025	.659	.024
ABS						

CONFIDENTIAL
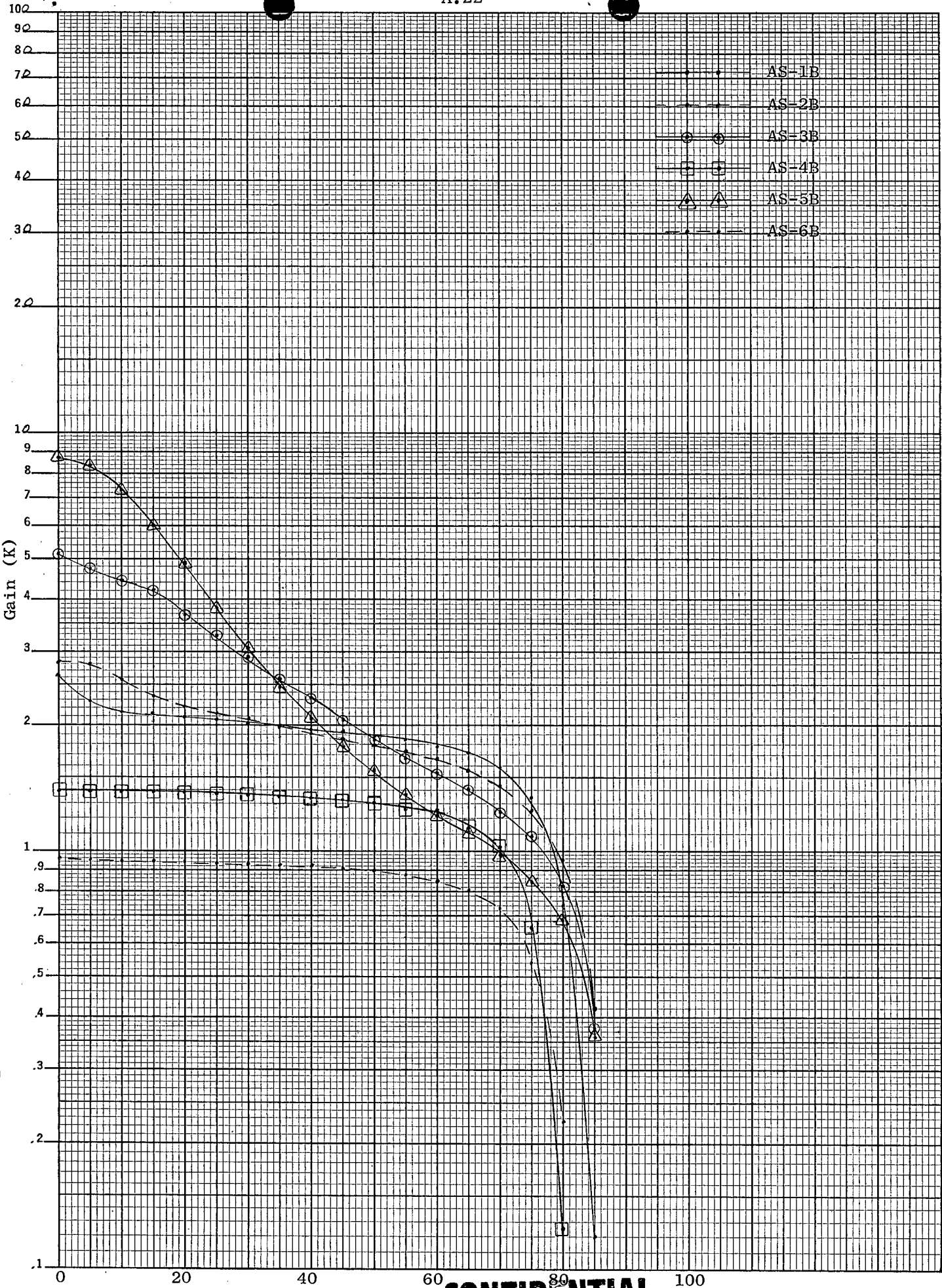
CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AS-7A	AS-8A	SAMPLE CODES AS-9A	AS-10A	AS-11A	
0	5.428	5.853	2.182	10.063	7.039	.000
5	4.880	5.080	2.171	7.508	5.744	.000
10	4.382	4.472	2.161	4.992	4.843	.000
15	3.934	3.782	2.161	4.156	4.167	.000
20	3.485	3.092	2.118	3.638	3.547	.000
25	3.087	2.622	2.065	3.173	3.041	.000
30	2.689	2.263	2.033	2.802	2.618	.000
35	2.440	2.070	1.970	2.438	2.252	.000
40	2.191	1.932	1.949	2.167	1.971	.000
45	2.016	1.849	1.906	1.950	1.779	.000
50	1.892	1.739	1.864	1.718	1.633	.000
55	1.742	1.711	1.822	1.664	1.520	.000
60	1.643	1.601	1.716	1.579	1.407	.000
65	1.543	1.529	1.631	1.470	1.295	.000
70	1.444	1.435	1.525	1.370	1.182	.000
75	1.244	1.270	1.334	1.161	1.070	.000
80	.995	1.049	1.038	.967	.844	.000
85	.348	.563	.254	.541	.467	.000
90	.000	.000	.000	.000	.000	.000
============	=========	=========	=========	=========	=========	=====
TS	.866	.825	.757	.874	.801	.000
T45	.417	.374	.296	.439	.410	.000
TSP	.0281	.0526	.0228	.0667	.1051	
V45	.458	.519	.067	.675	.596	
ABS						

CONFIDENTIAL
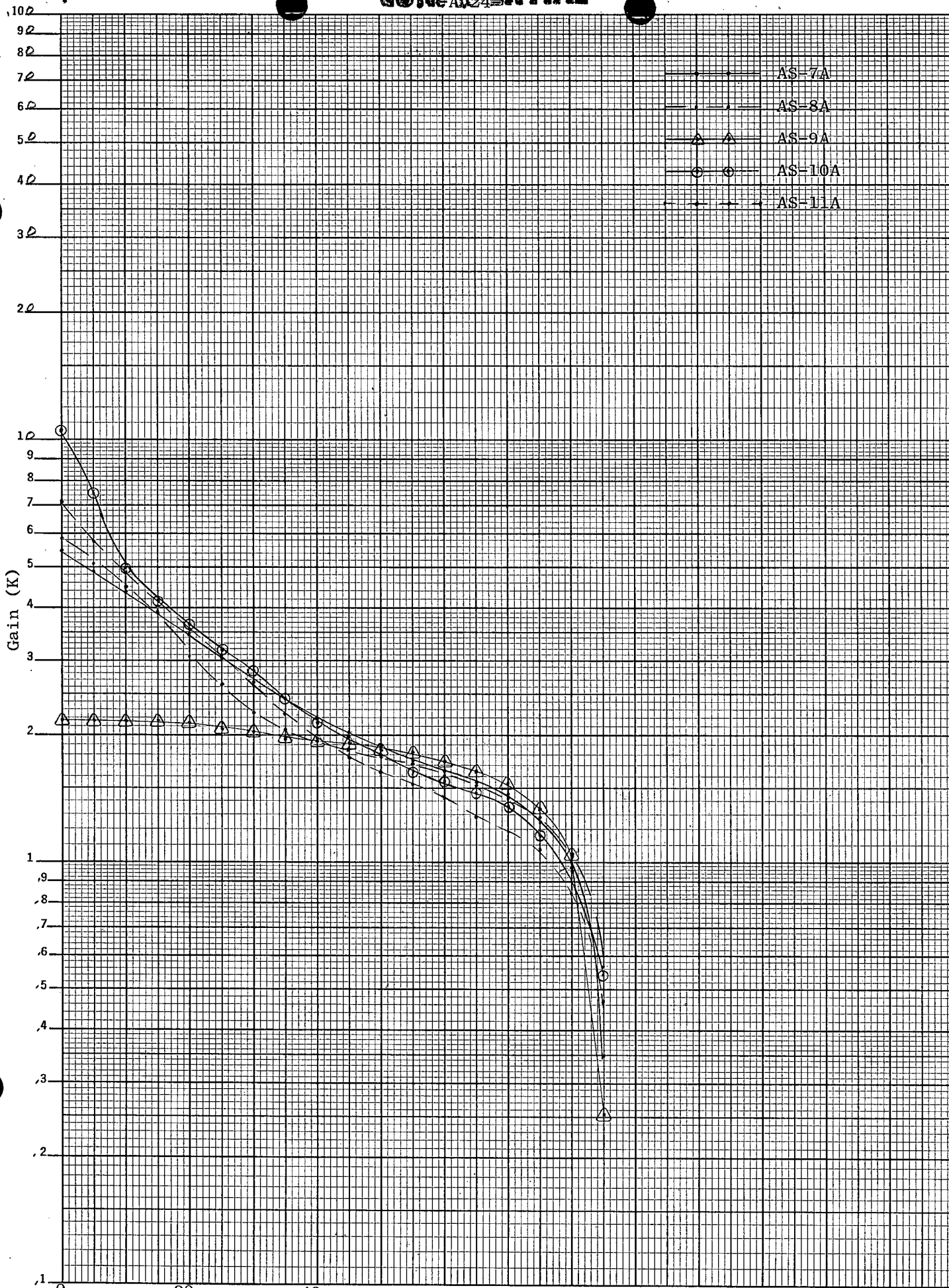
CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AS-7B	AS-8B	AS-9B	AS-10B	AS-11B	
0	2.483	2.157	1.326	2.521	2.569	.000
5	2.427	2.104	1.319	2.471	2.544	.000
10	2.373	2.051	1.310	2.397	2.505	.000
15	2.321	2.002	1.287	2.323	2.446	.000
20	2.267	1.955	1.280	2.254	2.384	.000
25	2.218	1.912	1.275	2.182	2.312	.000
30	2.164	1.866	1.264	2.125	2.240	.000
35	2.102	1.817	1.259	2.068	2.161	.000
40	2.033	1.764	1.245	2.002	2.094	.000
45	1.967	1.713	1.227	1.940	2.022	.000
50	1.868	1.657	1.205	1.878	1.947	.000
55	1.807	1.594	1.178	1.804	1.855	.000
60	1.714	1.519	1.139	1.722	1.773	.000
65	1.623	1.424	1.095	1.626	1.654	.000
70	1.475	1.296	1.018	1.495	1.516	.000
75	1.229	1.115	.884	1.297	1.336	.000
80	.909	.839	.837	1.013	1.027	.000
85	.395	.318	.026	.432	.418	.000
90	.000	.000	.000	.000	.000	.000
===
TS	.770	.675	.489	.776	.803	.000
T45	.315	.272	.185	.311	.327	.000
TSP	.0146	.0136	.008	.0171	.0166	
V45	.115	.114	.038	.130	.119	
ABS						

CONFIDENTIAL
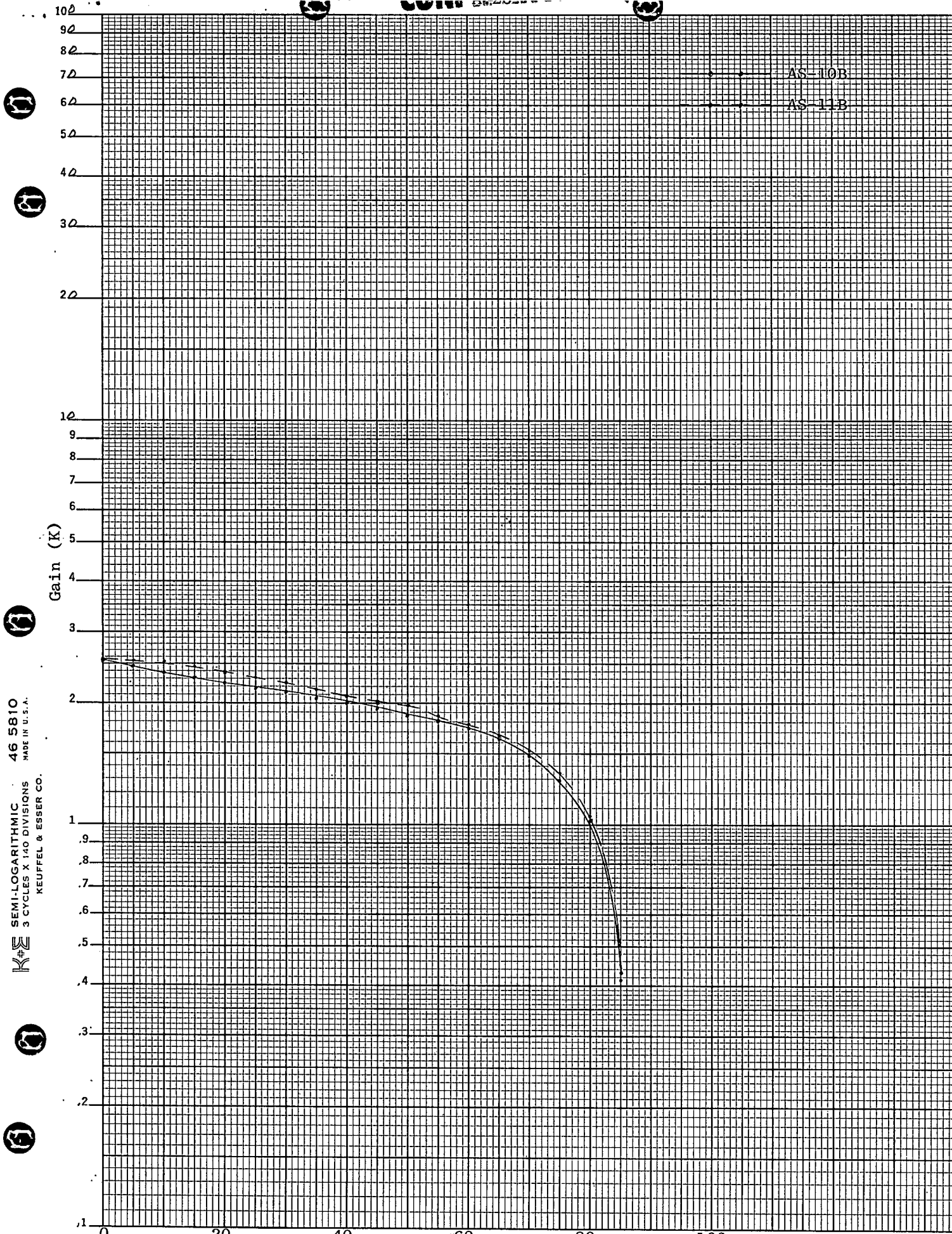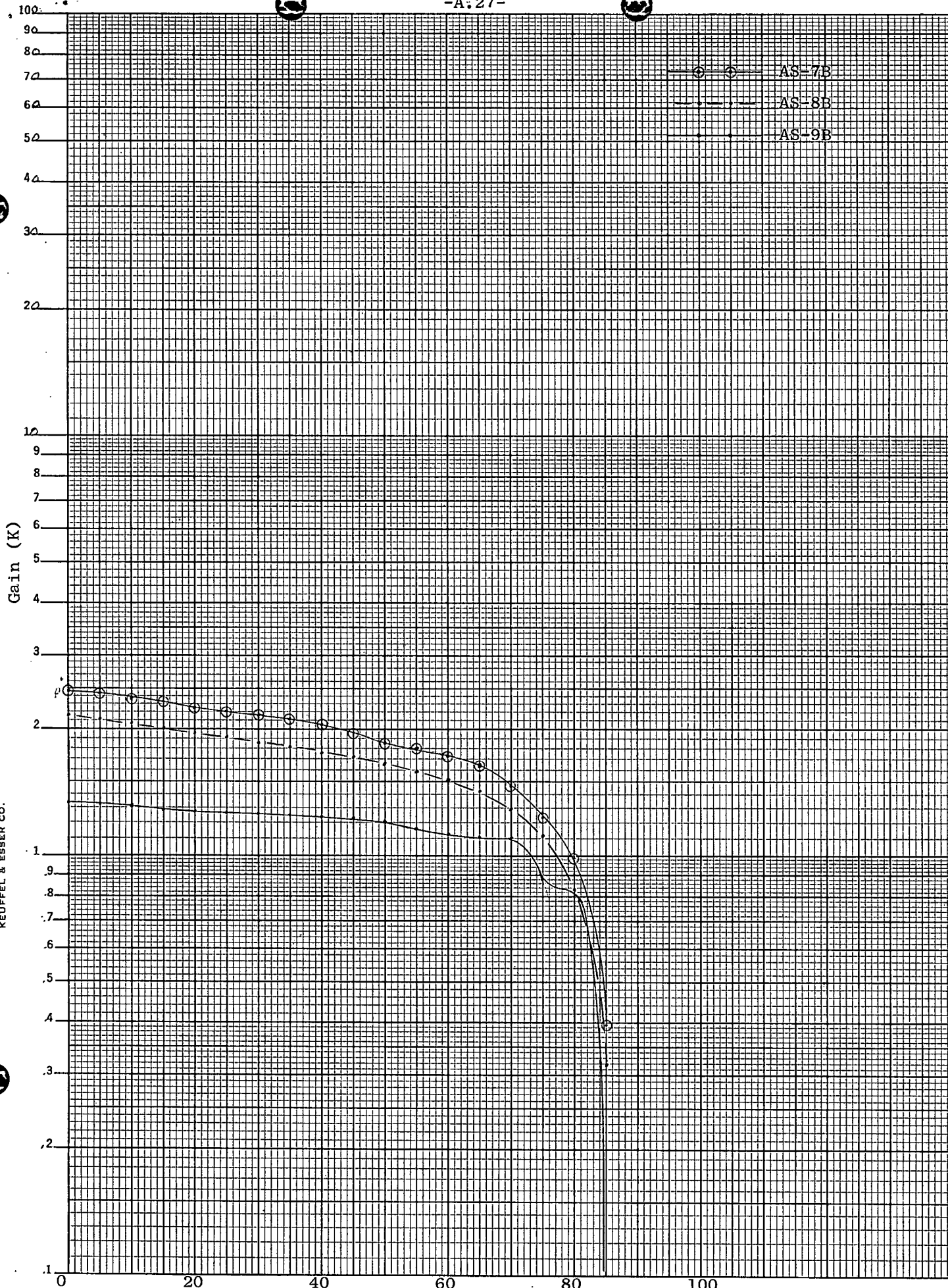
CONFIDENTIAL

SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	AU-1A	AU-2A	AU-3A	AU-4A	AU-5A	AU-6A
			SAMPLE CODES			
0	1.433	1.299	1.547	1.552	1.187	1.339
5	1.433	1.270	1.539	1.552	1.187	1.332
10	1.433	1.256	1.532	1.545	1.181	1.326
15	1.368	1.256	1.524	1.545	1.181	1.312
20	1.303	1.256	1.509	1.537	1.176	1.312
25	1.303	1.256	1.501	1.529	1.170	1.306
30	1.303	1.256	1.486	1.529	1.164	1.299
35	1.290	1.256	1.471	1.521	1.152	1.292
40	1.277	1.241	1.460	1.490	1.140	1.286
45	1.264	1.227	1.448	1.475	1.129	1.279
50	1.238	1.183	1.441	1.459	1.117	1.259
55	1.212	1.154	1.395	1.428	1.105	1.232
60	1.199	1.126	1.365	1.382	1.081	1.205
65	1.140	1.097	1.319	1.304	1.023	1.138
70	1.055	1.025	1.183	1.195	.940	1.071
75	.925	.909	1.046	1.055	.846	.924
80	.443	.490	.804	.807	.640	.709
85	.000	.000	.394	.372	.282	.375
90	.000	.000	.000	.000	.000	.000
=======	=======	=======	=======	=======	=======	=======
TS	.487	.470	.586	.593	.459	.516
T45	.191	.183	.217	.222	.169	.190
TSP	.0007	.0008	.001	.0009	.0007	.0007
V45	.062	.028	.033	.025	.025	.022
ABS						

CONFIDENTIAL
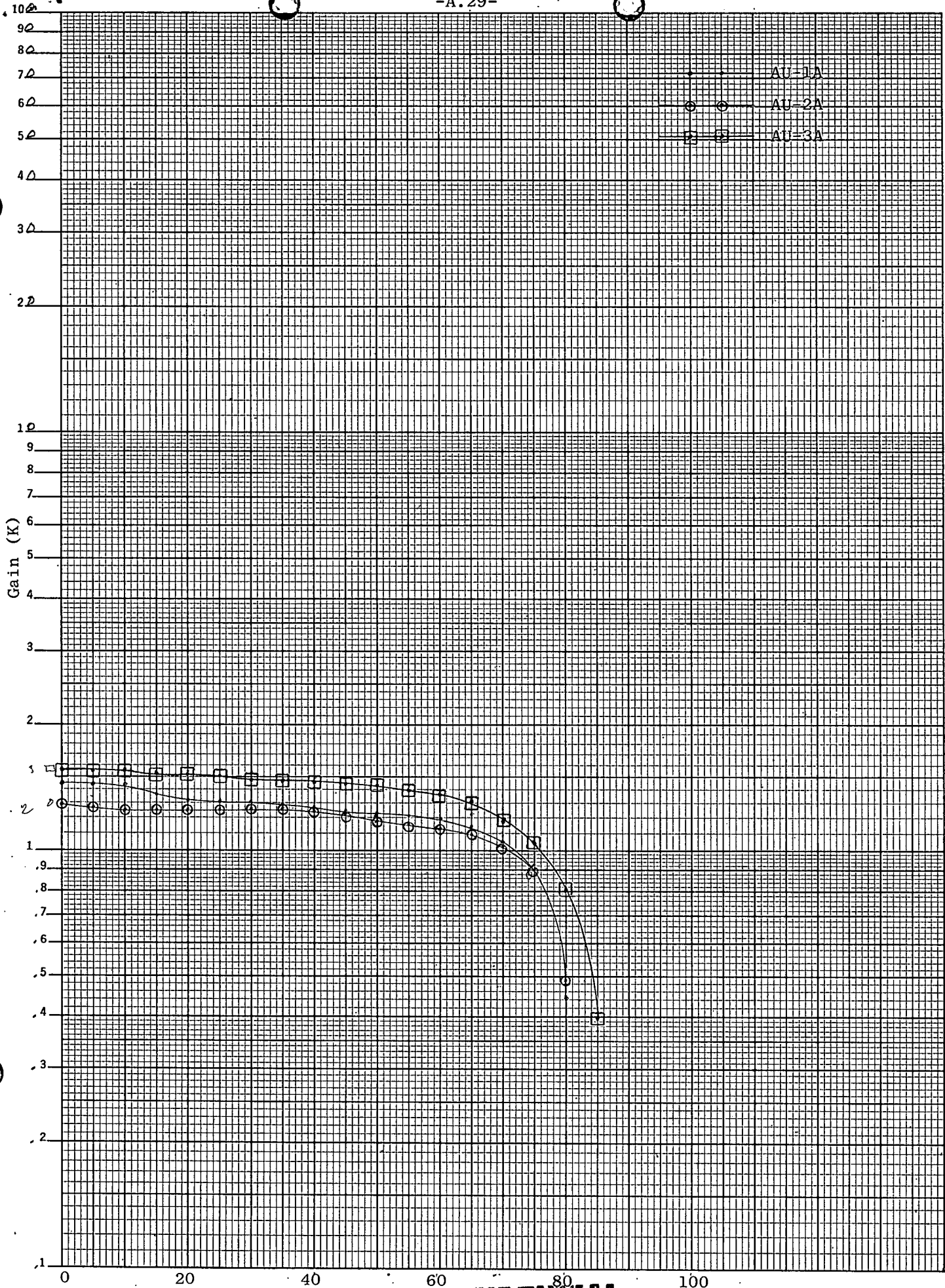
-A. 30-
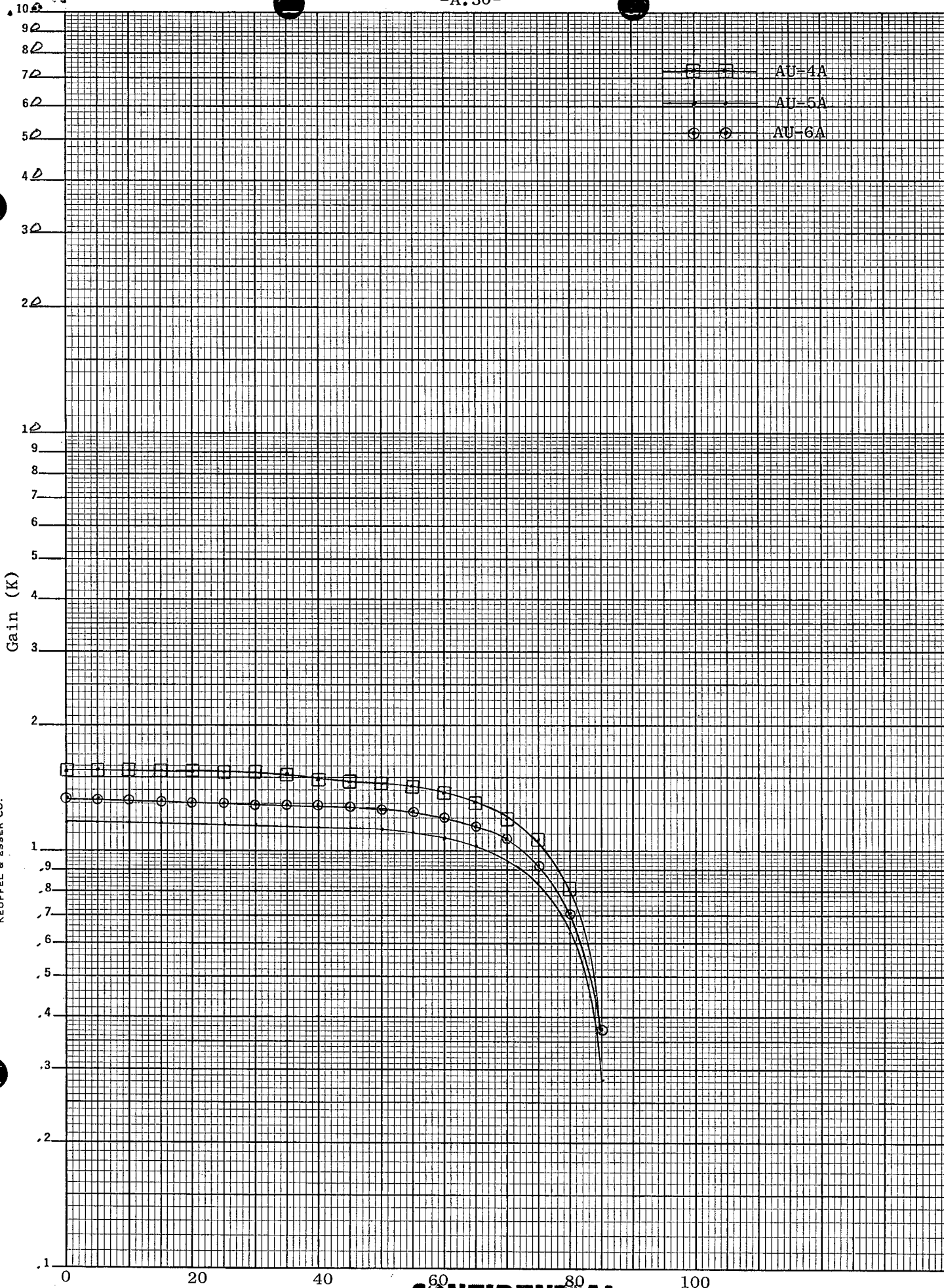
SUMMARY OF ANGULAR GAIN FUNCTIONS

ANGLE K	SAMPLE CODES AU-1B	AU-2B	AU-3B	AU-4B	AU-5B	AU-6B
0	.676	.633	1.459	.585	.569	.753
5	.676	.633	1.347	.583	.569	.750
10	.676	.633	1.290	.582	.568	.748
15	.673	.630	1.234	.580	.567	.744
20	.669	.627	1.122	.577	.562	.741
25	.666	.624	1.111	.575	.558	.738
30	.663	.621	1.105	.572	.555	.731
35	.656	.614	1.100	.568	.550	.723
40	.649	.608	1.094	.563	.545	.712
45	.642	.595	1.088	.555	.540	.701
50	.629	.582	1.055	.546	.532	.686
55	.615	.563	1.032	.535	.520	.664
60	.598	.544	.999	.519	.501	.637
65	.568	.512	.942	.501	.475	.603
70	.527	.473	.898	.443	.434	.557
75	.466	.416	.785	.373	.376	.467
80	.368	.307	.606	.131	.226	.128
85	.142	.038	.224	.000	.000	.000
90	.000	.000	.000	.000	.000	.000

===

TS	.258	.231	.435	.208	.207	.260
T45	.096	.090	.165	.083	.081	.106
TSP	.004	.0035	.006	.0035	.003	.004
V45	.025	.030	.145	.026	.026	.035
ABS						

A-32