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cc: 1A Graves
2A Ogle
3A J-10
4A J-10 Cox, Sandia
5A J-10
6A J-10

1081

PRELIMINARY BLAST SUMMARY - OPERATION IVY

December 22, 1952

F. B. Porzel

[redacted]

RS 3466-141747

135192

1. GENERAL

This supplements my memorandum dated November 22, 1952, J-15162, "Preliminary Blast Summary - Operation Ivy". It is concerned with a more detailed presentation of the blast data, based on the Sandia results as of December 15th, rather than their earlier numbers as read in Eniwetok. Two major conclusions seem to result from these data: (1) The agreement is excellent between Sandia's measurements and the purely theoretical predictions of LA-1406; there is also worthwhile evidence of a possible revision of the MIKE hydrodynamic yield downward to 10 ~~to 12~~ megatons.

2. KING SHOT

The argument for revision of the hydrodynamic yield on MIKE is based in part on the degree of reliance which can be attached to the same hydrodynamic data as it was used on KING.

Figure 1 shows the time of arrival for KING shot. This excellent agreement was previously noted because it had been used as a method for checking the actual blast position of KING as determined by Fussell. It is significant here in showing that the basic time of arrival curve (and the necessary transformations through the height of burst curves to correct for the finite height of burst) leads to predicted times of arrival which are "pencil-width" correct. Incidentally, note the early times of arrival over land in comparison with both the theoretical prediction and the measured values over water; this is due to precursor action from the thermal effect; it is strikingly

O-1 Ivy

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evident on the pressure-time curve; Sandia's time of arrival refers of course to the pressure rise in the "thermal shock .

Figure 2 shows the peak pressure vs. distances over land and water. Here again the agreement with the theoretical predictions is considered excellent, both over land and water. Note the return of the thermal curve to approach the ideal values near 8 psi. Further, beyond 10,000 feet the pressures are below ideal, indicating that the effect of atmospheric inhomogeneity sets in somewhere beyond 10,000 to 15,000 feet.

Figure 3 shows the positive duration vs. horizontal distances. The theoretical curves are not exact; for simplicity, I have used here the positive duration of a free air curve with a reflection factor of 2. For a bomb at altitude, the close-in positive duration should be more nearly like 1/2 the tonnage indicated here. On the curves, the two close-in ideal surface positive durations are, in fact, shorter than indicated but at large distances for the positive durations become much longer than predicted. This is attributed to atmospheric inhomogeneity setting in beyond 15,000 feet. Note also that the positive durations are considerably longer over land than over water; this is again due to thermal effect and precursor action, with some reinforcement of the blast wave from thermal radiation.

3. MIKE SHOT

During his visit last week, Lew Fussell reported that the more recent fireball measurements are giving values of ∅ like 268 from the Parry-Eastman films, and 278 from the Engebi Rapatronics. The fireball measurements at Parry, which resulted in the fireball yield of 12 megatons, was based on data whose ∅ values were more like 277; now the Engebi measurements will be large because the apparent size of the fireball is measured by the tangent to the fireball, and at these close-in distances, the proper correction will reduce these values of ϕ to something like 272. Also, there may be appreciable halation on these films and I would consider, for the moment, that the Parry - Eastman value of 268 is probably more reliable. If the fireball data are then revised downward, indicated by ϕ = 268, the apparent yield from MIKE shot will then be in the order of 10.2 megatons, even by the analytic solution.

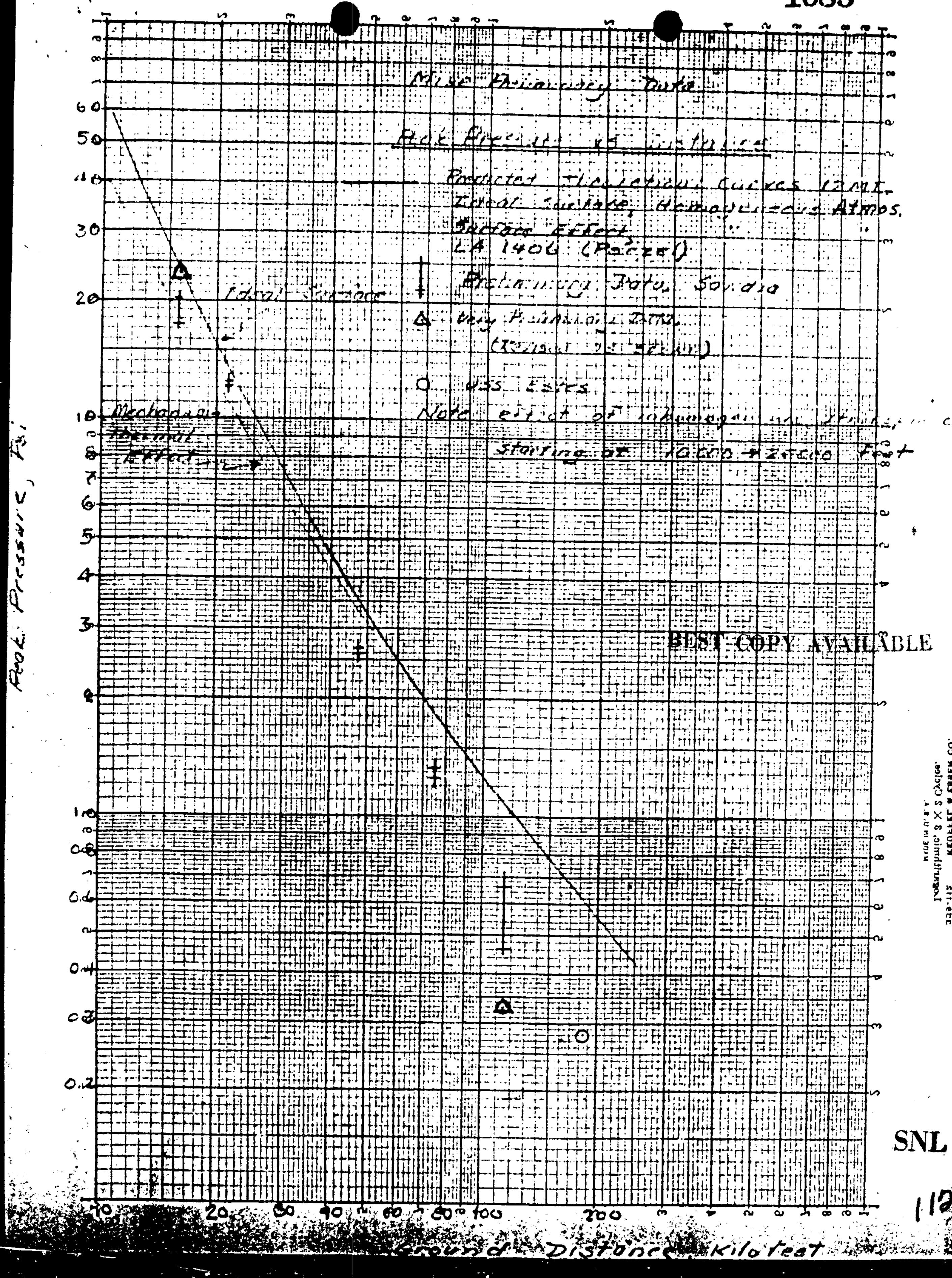
Figure 4 shows the time of arrival curve from MIKE in comparison with the predicted times of arrival for both 10 and 12 megatons. I have included some preliminary fireball points, from measurement at Eniwetok, shown as crosses, and the fireball curve resulting from a ϕ of 268 shown as a dashed line. Sandia's measured times of arrival are shown by circles. In view of the excellent correlation obtained by this same prediction on KING, the times of arrival at 8300 feet and 16,000 feet seem significantly closer to 10 megatons than 12. Beyond 15,000 feet atmospheric inhomogeneity will result in later times of arrival. Only one point on the time of arrival curve is high, at 36,000 feet; this point was not included by Cox in his most recent publication of results; I have carried it over from the estimates on Parry to show that there is a reasonable possibility, although small, that the time of arrival curve is like 12 megatons in this region, and that on Eniwetok it had been included as part of the judgement that the time of arrival curve was reasonable for 12 megatons.

Figure 5 shows the peak pressure vs. distance curve for MIKE; generally two different pressures were measured at the same distances. At 16,000 feet, Cox has revised the pressure downward from an original 23.6 psi down to a spread between 20.2 and 17.4 psi. This was a station close to water and had a fairly good wave form; I think this downward revision is again evidence that 12 megatons is high in this region. Further revision was made by Cox in revising the pressure on Parry from an original 0.36 psi up to a spread between .46 and .66 psi and in view of the difference in damage on Parry from the two shots. Even allowing for the slow rise time on MIKE, this revision is difficult to understand in comparison with the 0.33 psi for KING; on the other hand, it is more consistent with the theoretical predictions for a homogeneous medium. The intermediate stations have changed very slightly from the original numbers. However, the downward revision at close-in and the upward revision far out result in reducing the apparent magnitude of the atmospheric inhomogeneity. Whereas the Parry measurements indicated that the pressures would extrapolate to ideal values short of 15,000 feet, the present data would indicate that the peak pressures are low for 12 megatons even at close-in distances. The results are not clear-cut without further study because of the interference of surface effects.

Figure 6 shows the positive duration for MIKE shot. Here again one notes the abnormally long positive durations at almost all distances, which is attributed to atmospheric inhomogeneity and reinforcement of the blast wave by thermal radiation.

4. CONCLUSIONS

In general, the agreement of these measured data with the purely theoretical predictions of LA-1406 is significant in showing that basic field variables are well understood, theoretically and experimentally. In view of the possible revision of the fireball data downward and the hydrodynamic data on MIKE, it is recommended that for the time being the hydrodynamic yield be quoted somewhat lower than before - perhaps as "10 to 12" megatons, instead of 12 ± 1.



Predicted
Atmos.
LA 1406
Sandia
Note effect of
Starting at
Feet
Mechanical
Thermal
Effect
Peak Pressure, Psi
Ground Distance, Kilo feet
60
50
40
30
20
10
8
7
6
5
4
3
1.0
0.8
0.6
0.4
0.2
20
30
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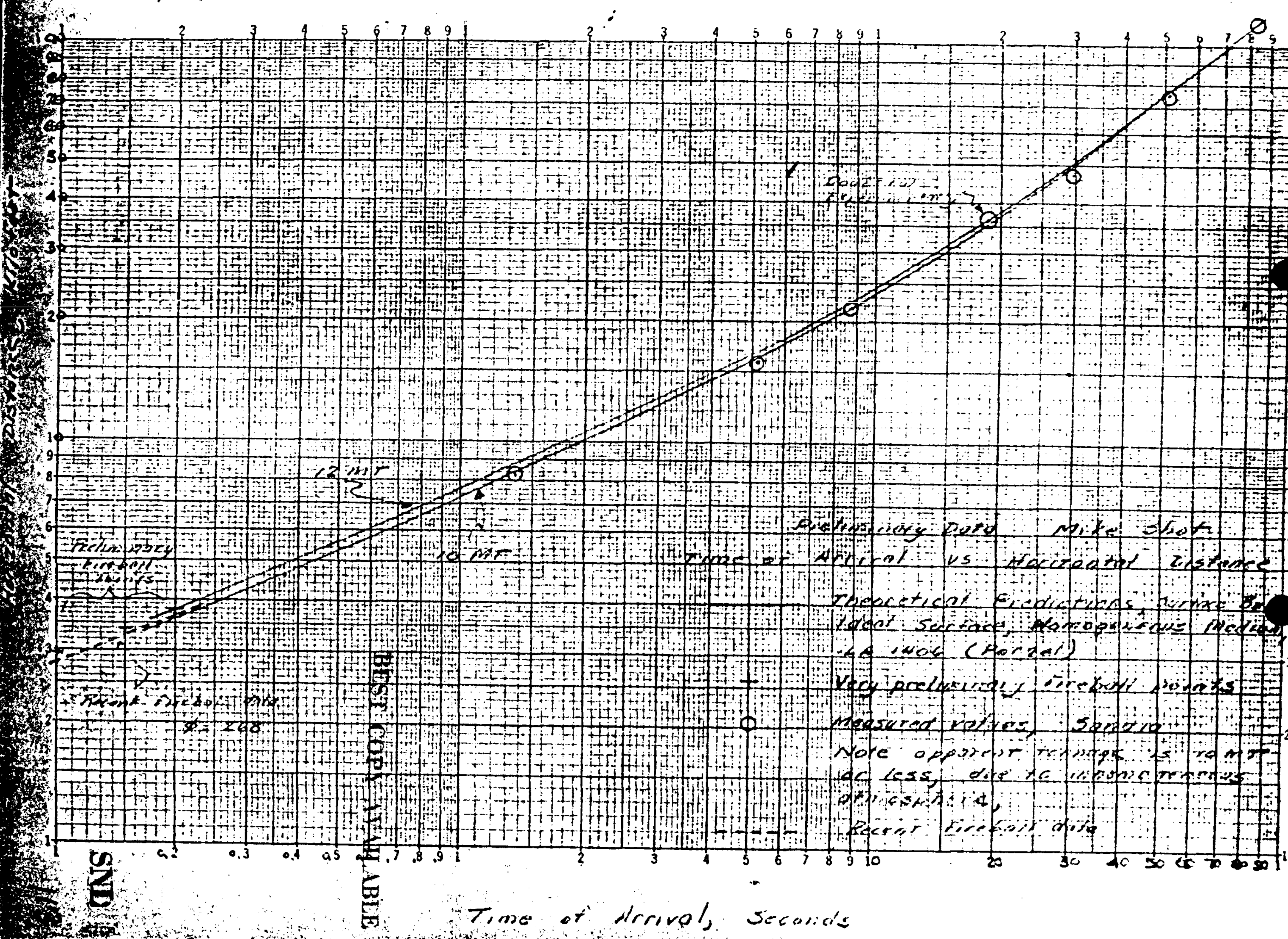
60
80
100
200

339-112 KEUFFEL & ESSER CO.
Logarithmic, 3 X 2 Cycles.
MADE IN U.S.A.



SND

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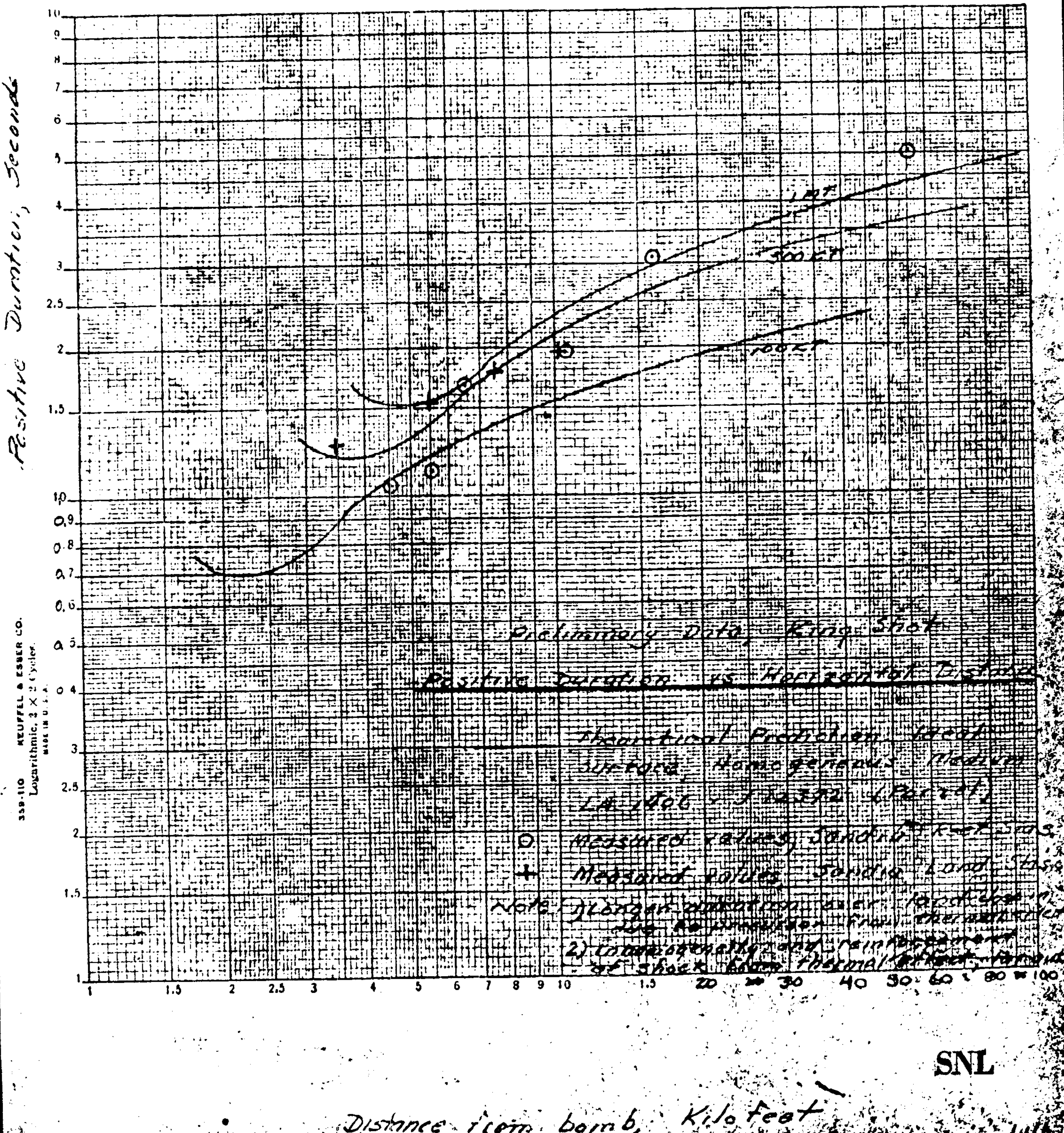

SNL

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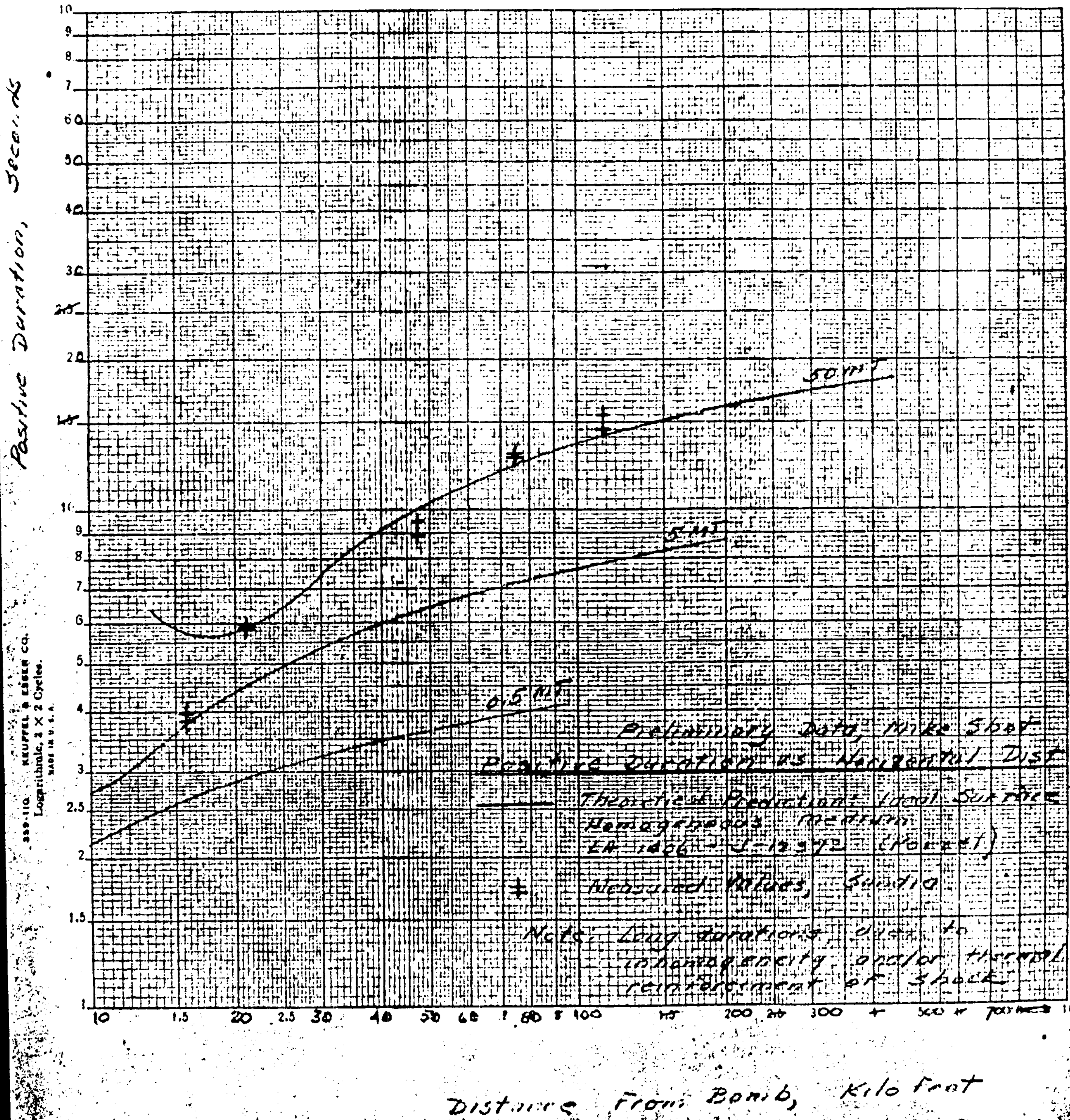

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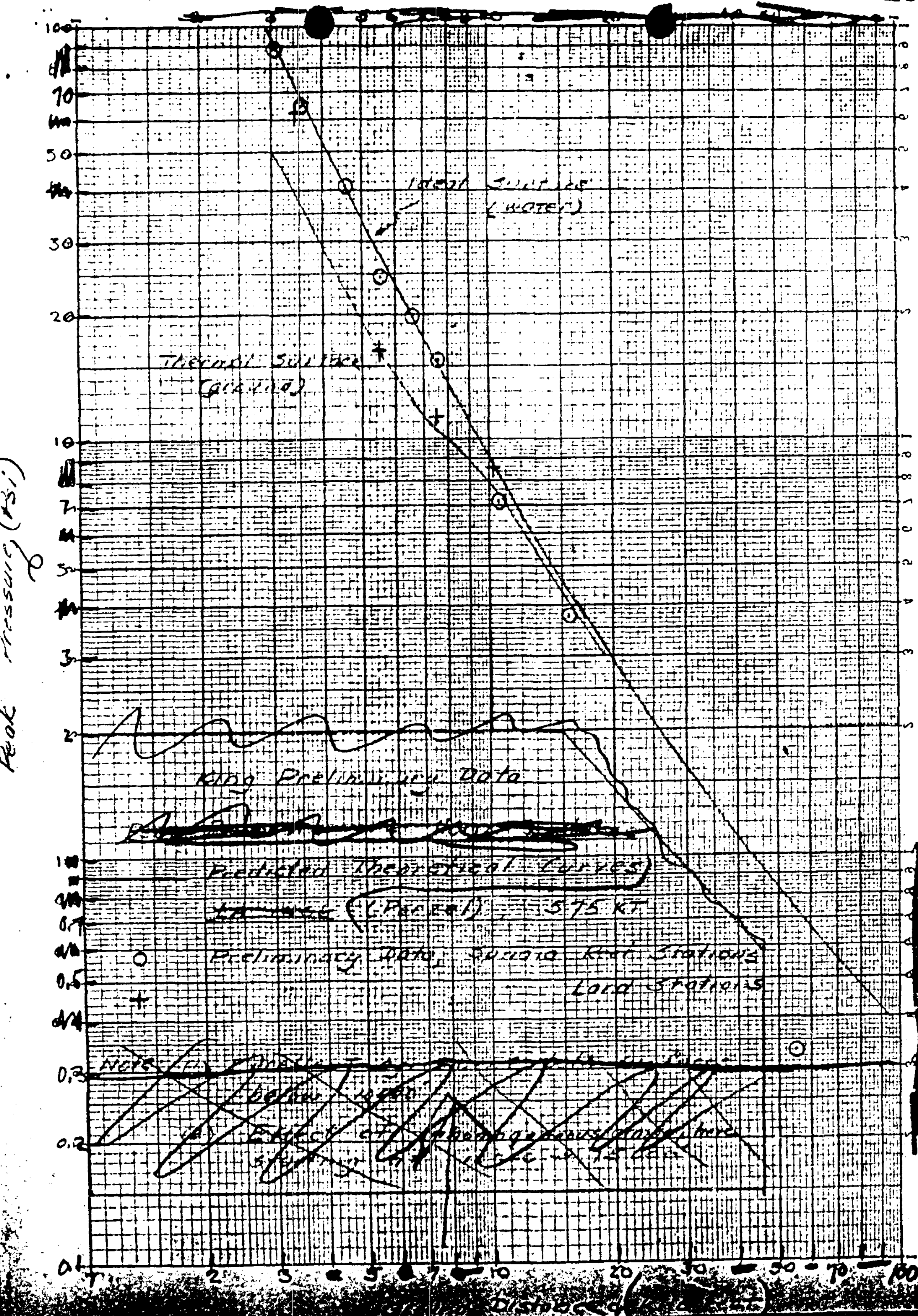
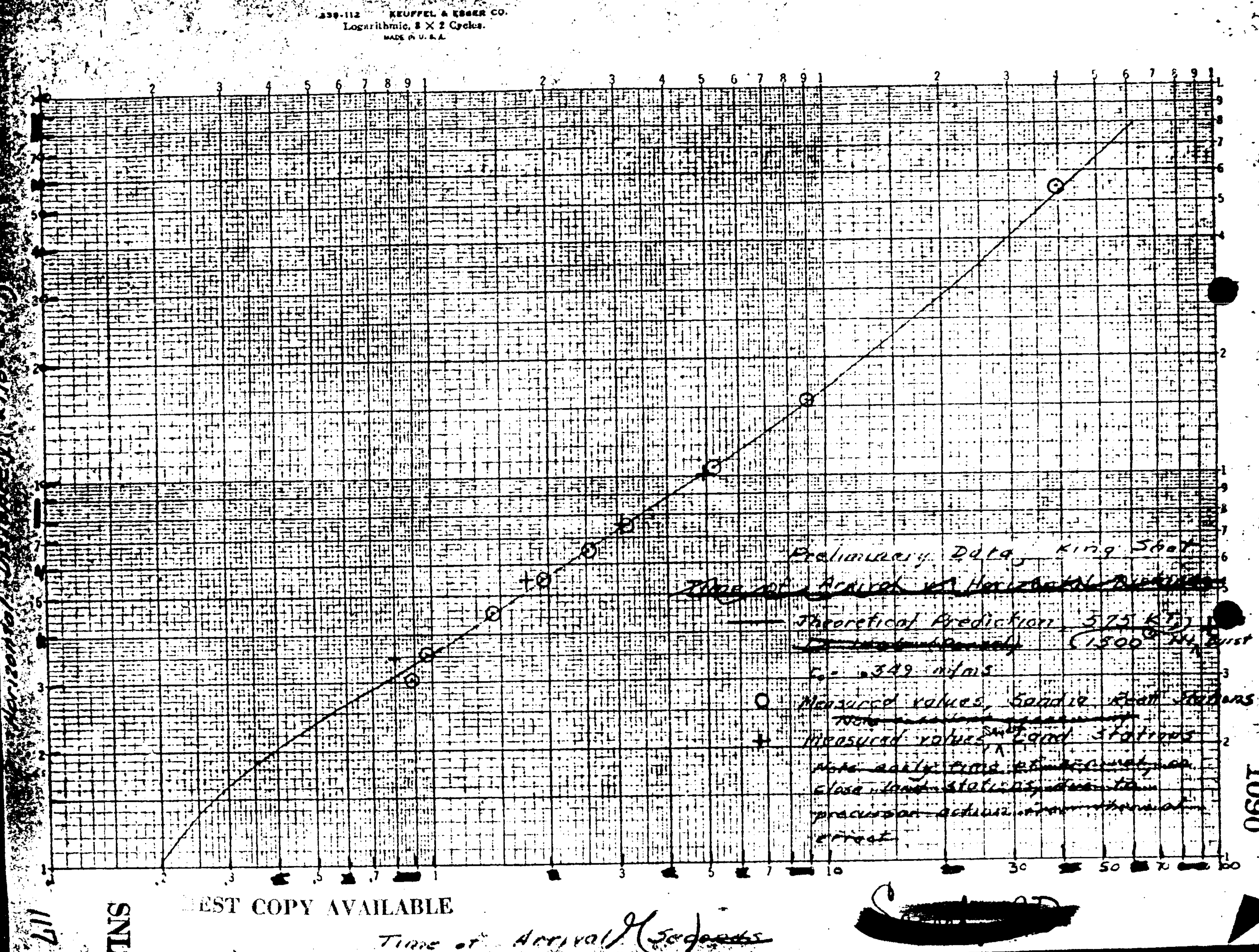
US


Ideal Surface (water)
Thermal Surface (gravel)
King Preliminary Data
Predicted Theoretical Curves
(Pascal) 575 KT
Preliminary Data, Ground Reef Stations
Land Stations
Peak Pressure (psi)
Distance

1090



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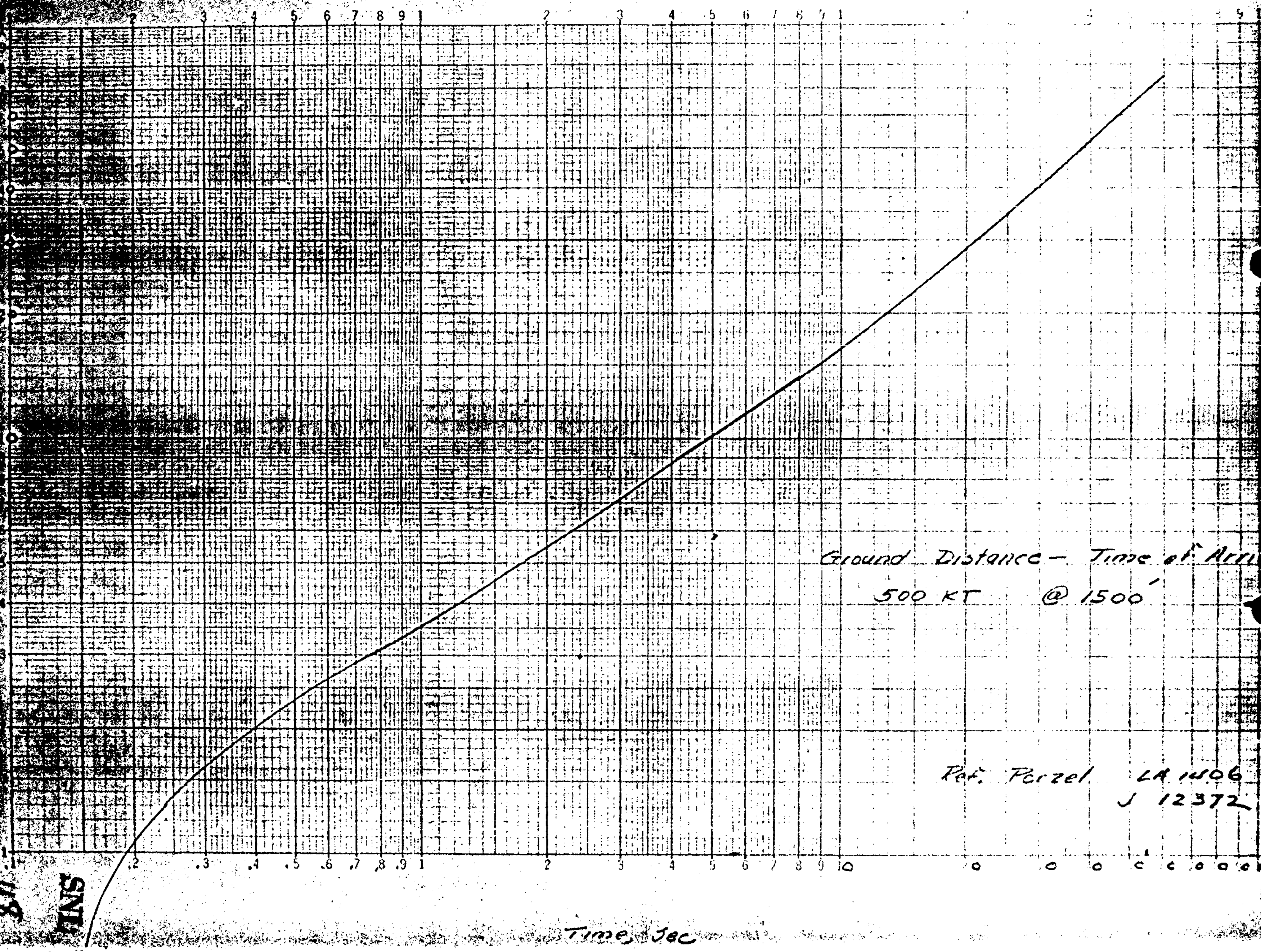
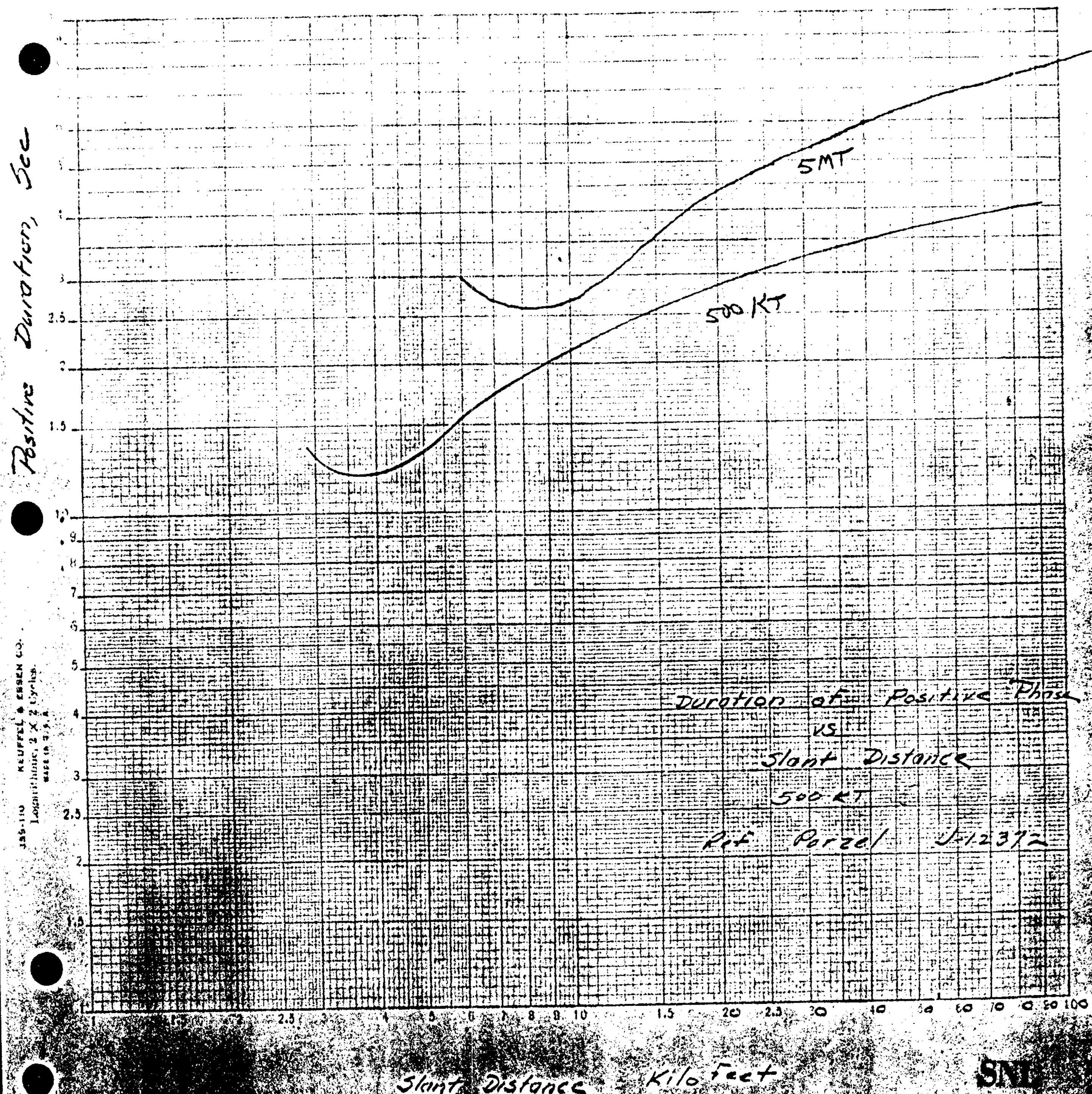
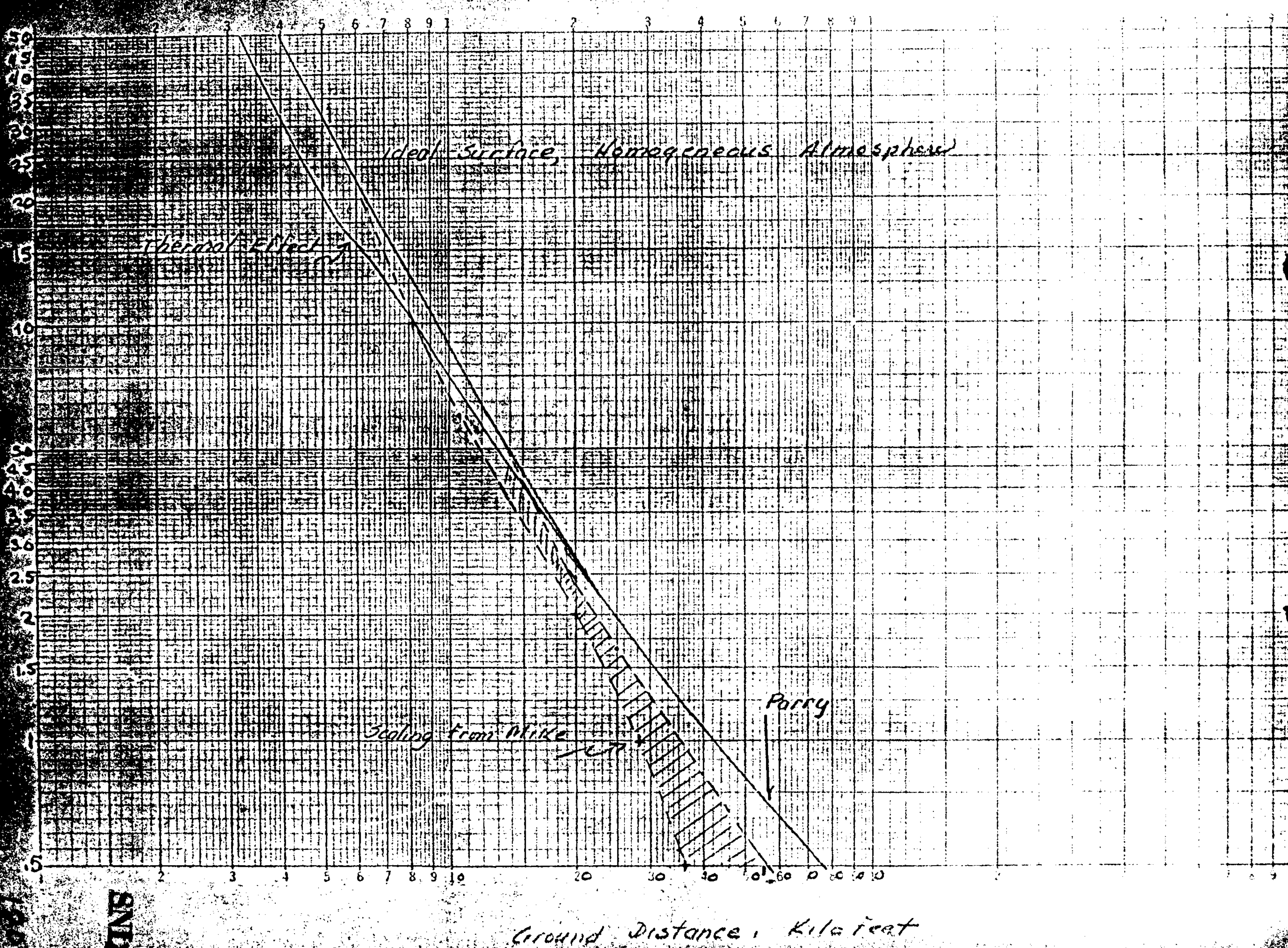

Ground Distance – Time of Arrival
500 KT @ 1500'
Ref: Porzel LA 1406
J 12372
Time, sec


Positive Duration, Sec
5MT
500 KT
Duration of Positive Phase
vs
Slant Distance
500 KT
Ref Porzel J-12372
Slant Distance, Kilo Feet



359-118 KEUFFEL & ESSER CO.
Logarithmic, 3 X 2 Cycles.
Ideal Surface, Homogeneous Atmosphere
Thermal Effect
Scaling from Mike
Parry
Ground Distance, Kilofeet

1094

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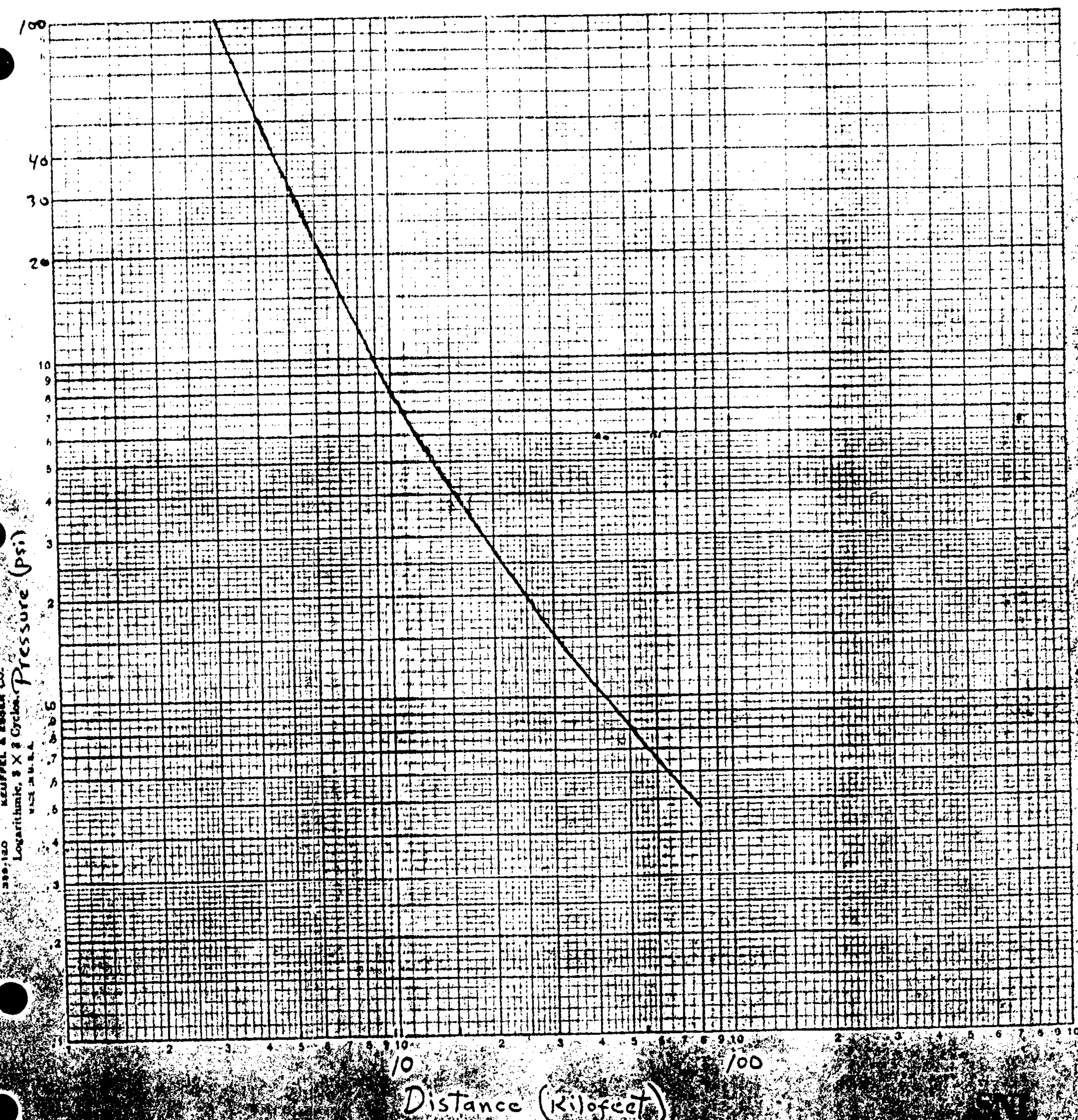
500KT



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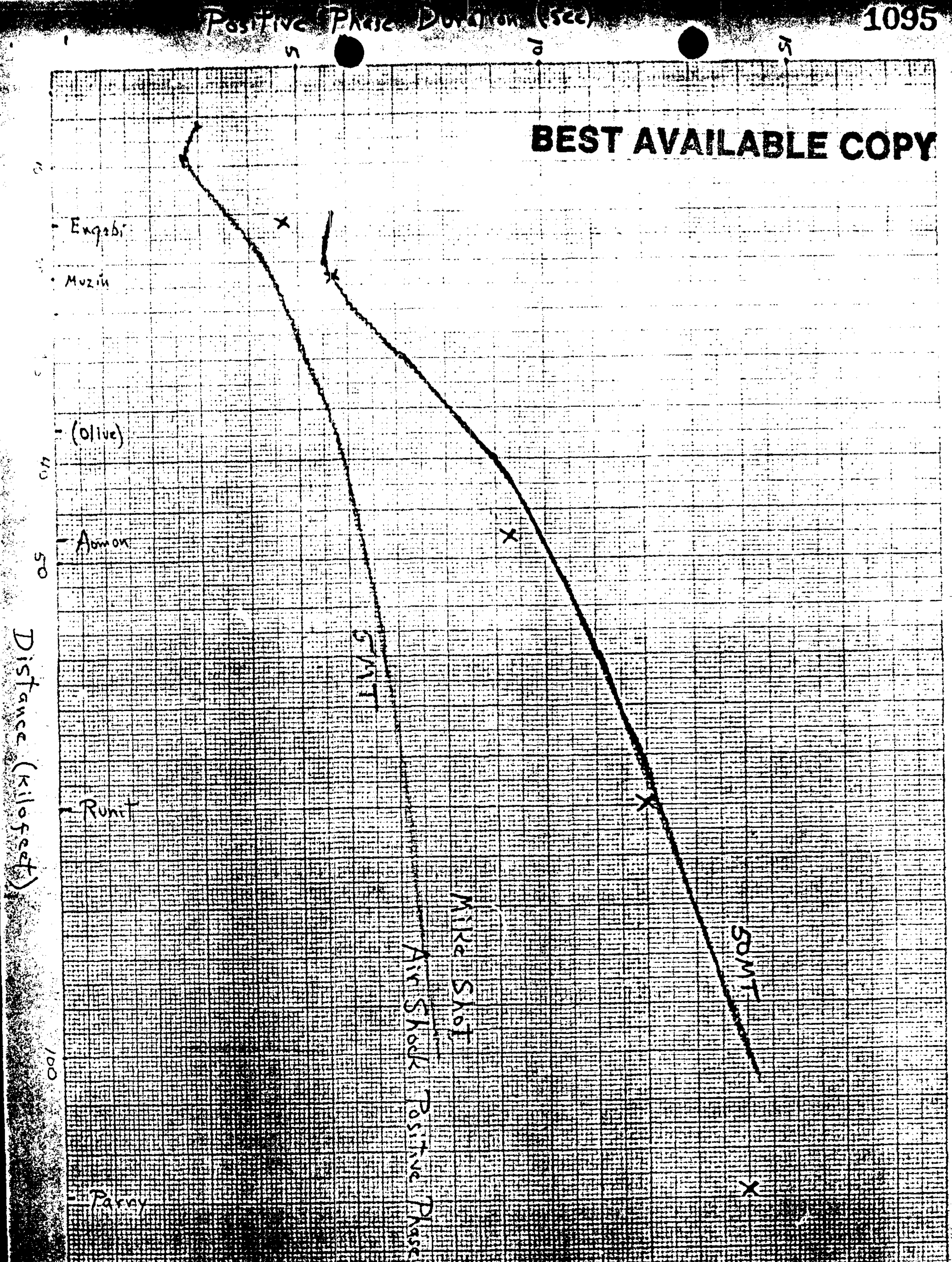

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