CSIRO - Australia Telescope National Facility

The Sidelobe Performance of the University of Tasmania Ceduna 30 m Antenna near 6.7 GHz

1. *Introduction*

Main beam and fist sidelobe patterns were measured using a total-power receiver in mid 1997. These measurements, which were carried out by University of Tasmania staff, were made near 6.7 GHz. This frequency is about 0.3 GHz higher than the operational upper limit used by Telstra, and the subreflector position had been "optimised" by Telstra to meet the sidelobe specifications at low elevation angles. The Telstra patterns obtained in 1980 while transmitting at 6150 MHz near an elevation angle of 5.2° are also used for comparison in this review.

The University of Tasmania used a strong source (3C273) giving a maximum elevation angle of 56°, and a weaker source (Hydra) to achieve a maximum elevation angle of 70°. These patterns were less accurate than the ones using 3C273.

In the next section, the results of the measurements are described and compared to the Telstra patterns. Finally, a procedure is proposed for carrying out tests to optimise the subreflector position to ensure improved performance across a larger elevation-angle coverage (say 5° to 75°).

2. *First-sidelobe Measurements*

Fig. 1 shows the level of the first sidelobes in both the azimuth (top) and elevation planes.

The patterns show the subreflector to be considerably out of focus for the azimuth plane, but in focus axially for the elevation plane. The levels of the first sidelobes for the azimuth patterns (which are seen to merge with the main beam) are relatively high (-12dB) on one side. The relative levels are approximately independent of elevation angle, which tends to indicate that the surface in the azimuth plane is not changing shape as the elevation changes. The elevation patterns do indeed show that the subreflector position had been optimised at low elevation angles, possibly by considering the elevation cuts only.

3. *Comparison with Telstra Results*

TBD

4. *Proposed Procedure for adjustment of subreflector*

The following information is provided for consideration in planning a program for resetting the subreflector.

- Currently, the azimuth patterns are highly misfocussed axially at all elevation angles. There is some minor unbalance in the transverse direction.

- The elevation patterns show equal sidelobes at an elevation angle of about 15°, with higher levels and increasing asymmetry (4dB) at higher elevation angles. The patterns indicate that the axial setting is about optimum for the elevation cuts.

- Comparing the results with the optical surveys of Kesteven and Parsons, the reason for the mild astigmatism is not clear. Consequently if a compromise axial subreflector position is to be obtained for both azimuth and elevation patterns, a subreflector movement of say 3 mm should be made, the direction (up or down) is uncertain.

- For the transverse (elevation plane) setting, a movement of say 4 mm in the up direction should be made and all patterns repeated with 3C273. Once an optimum position has been achieved, the subreflector should be finally adjusted in the (azimuth) transverse plane to achieve first sidelobe symmetry.

Bruce MacA Thomas
29 October 1997

Annex

Relevant Information from Optics Surveys carried out by M.J. Kesteven and B.F. Parsons (see CSIRO, ATNF report: "Ceduna-1 Second Survey", 19 June 1997).

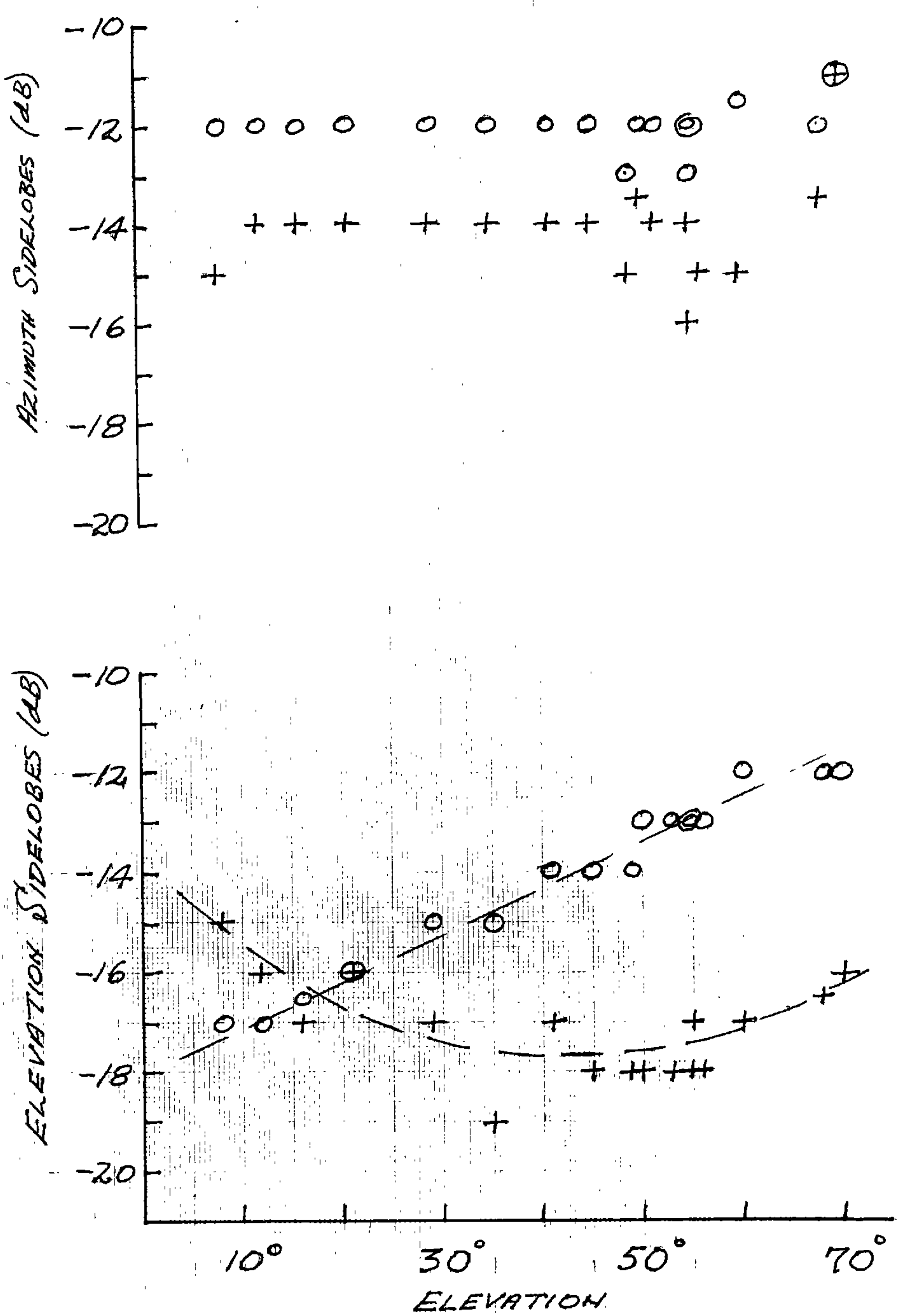
The results of Kesteven and Parsons indicate that the location of the subreflector can be optimised thus giving minimum variation in gainacross the typical elevation angle coverage (say 5° to 75°):

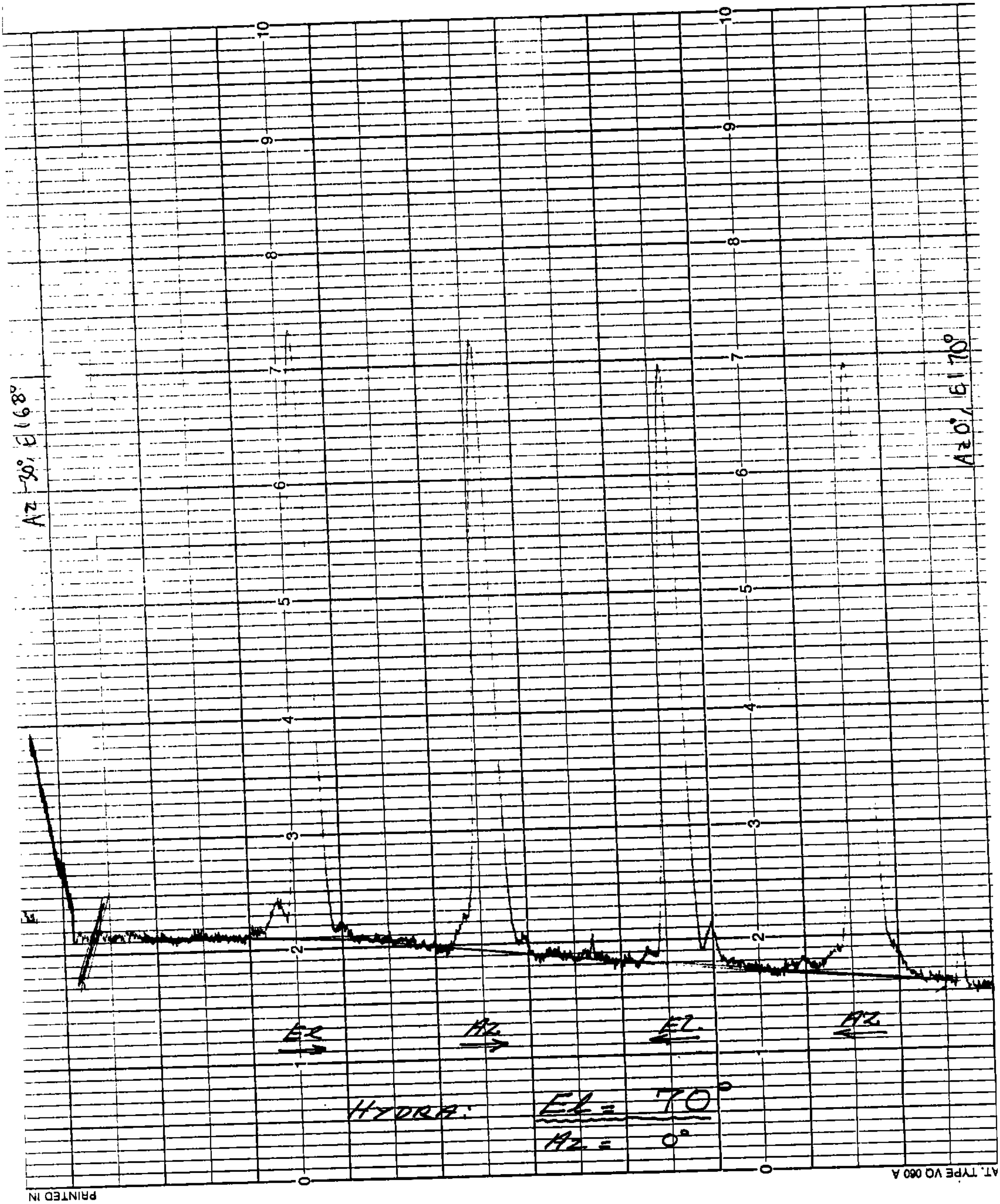
a) Axial position should be set near an elevation angle of 30° to give ± 4 mm misfocus at the elevation extremes. (At 22 GHz, this would represent 0.7 dB loss for a Cassegrain (un-shaped) antenna. For a "shaped" antenna, the loss needs to be determined, but could be double this).

b) The transverse position (elevation plane) should be adjusted at an elevation angle of 45°, to give a misfocus of ± 3 mm. The gain loss at 22 GHz is predicted to be insignificant for a Cassegrain antenna, but is not expected to be serious for a "shaped" antenna.

If the subreflector position is automated in the future, axial drive is recommended. Transverse drive is not, at this time, considered necessary. Note that pattern symmetry in the transverse plane may be improved across the elevation coverage by a small rotation of the subreflector with elevation angle, but this concept needs further investigation.

CEDUNA, ~6.7 GHz; MID-1997

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Az →
← El
← Az
HYDRA: El = 70°
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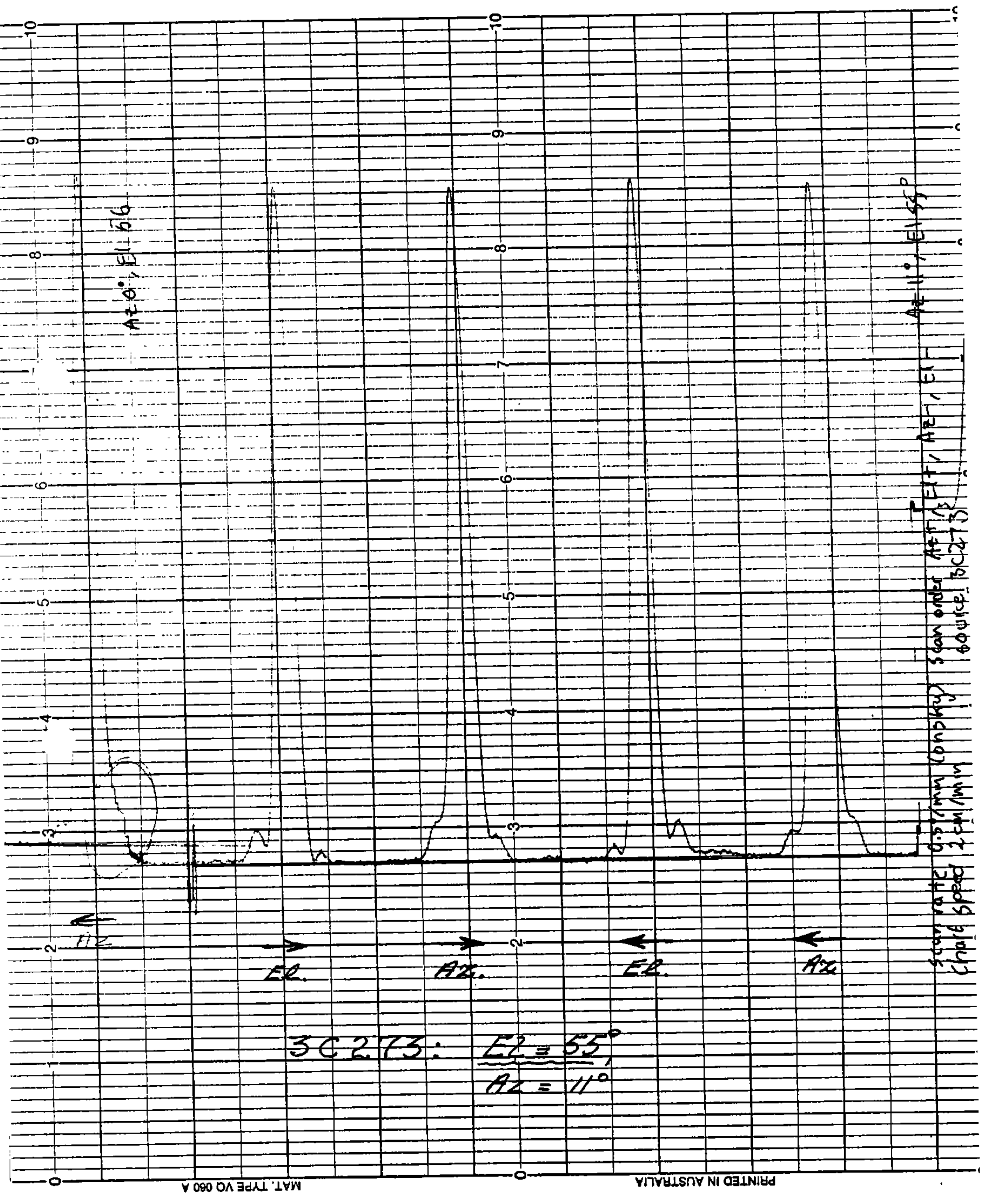

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Az.
El.
Az
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Chart speed 2 cm/min Source: 3C273
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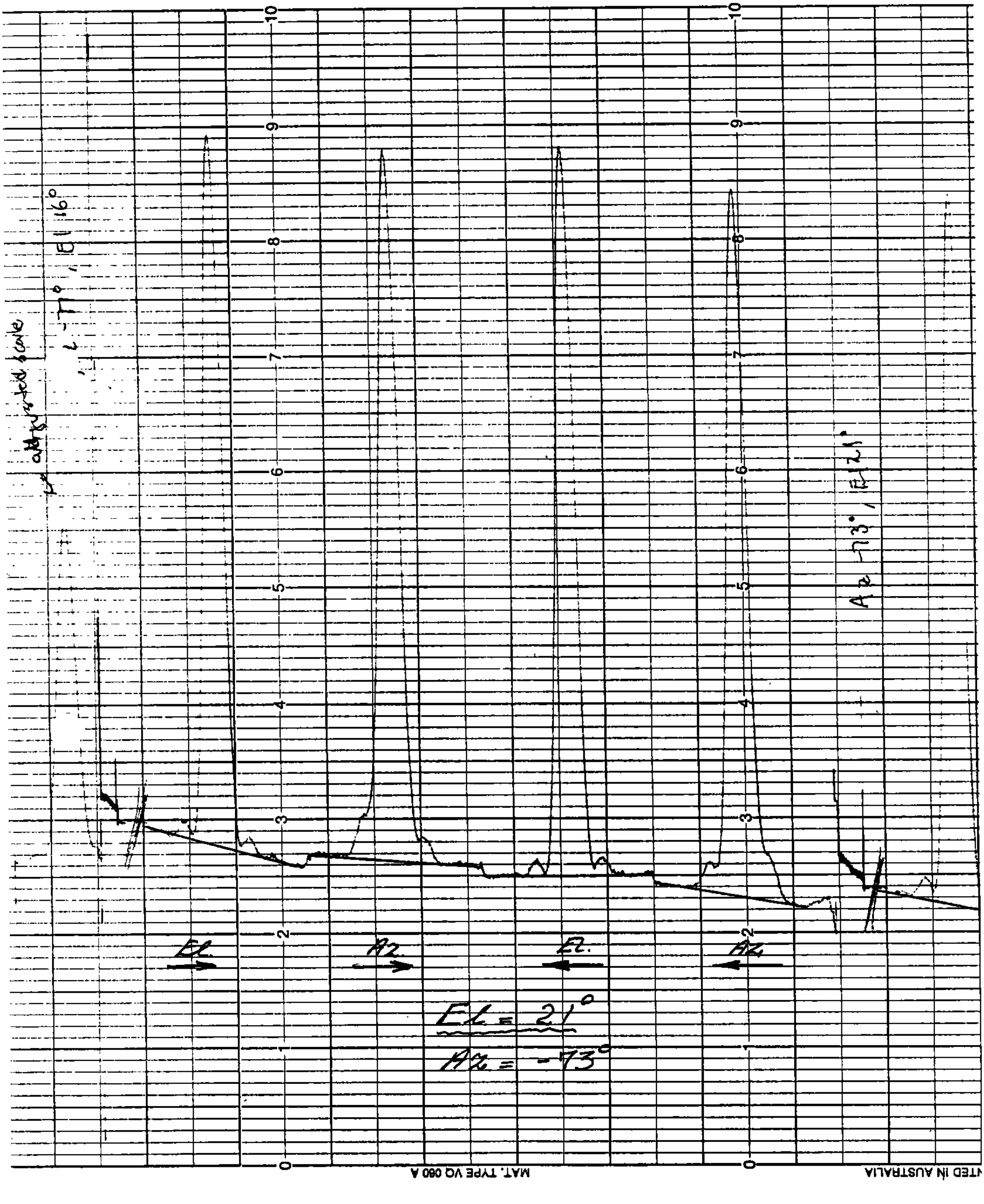
PRINTED IN AUSTRALIA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Az
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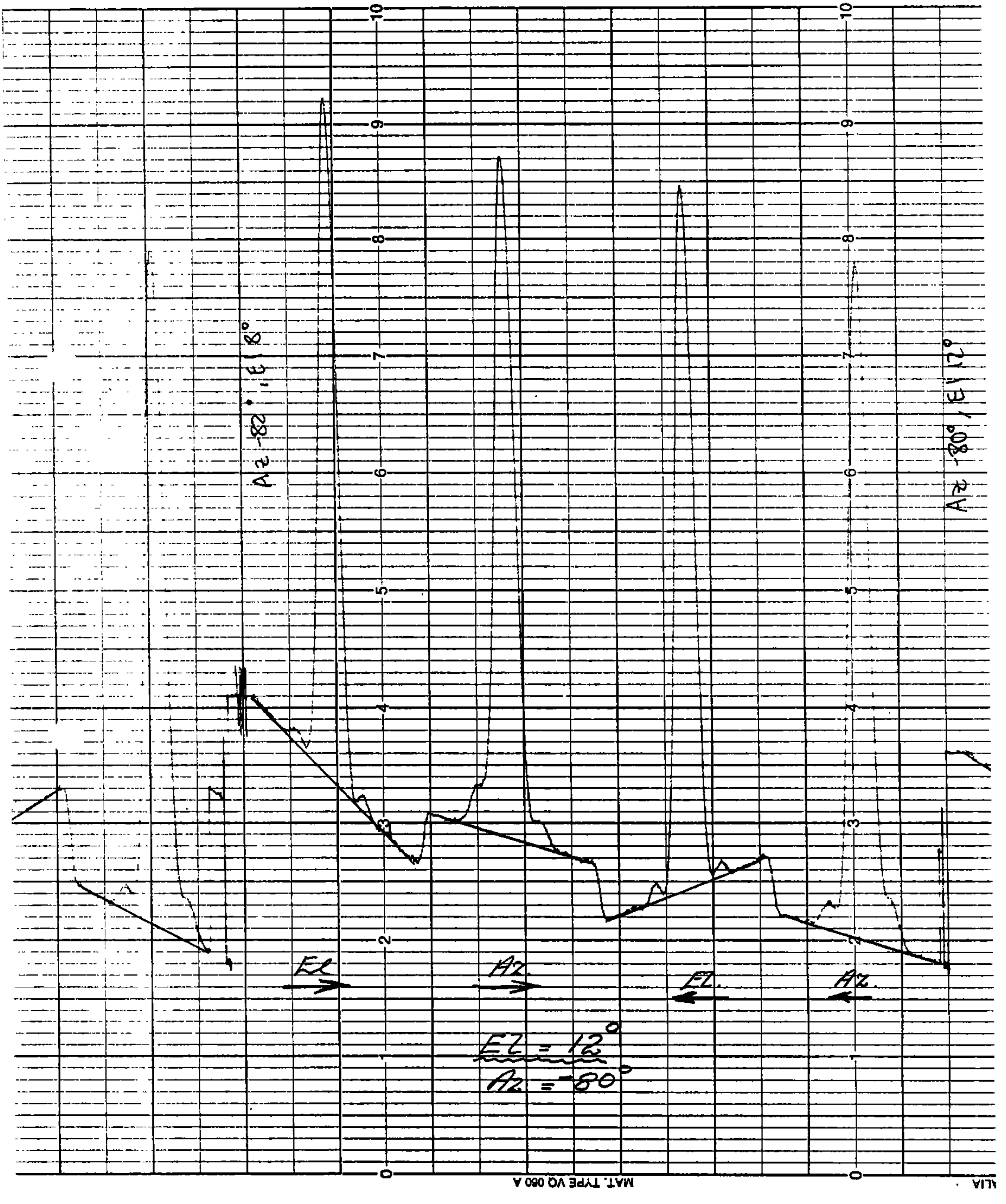
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