

1984/65. Calibration of SIE well logger probes.

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Abstract

Primary calibration of the Department's SIE gamma ray probe and gamma-gamma density probe was successfully carried out at SADME test pits. The calibration results are presented in usable form. SADME also provided advice on building equipment to calibrate the flowmeter and single point S.P./Resistivity probes.

INTRODUCTION

Primary calibration of downhole logging tools is desirable so that:

- (a) logs may be interpreted quantitatively rather than purely qualitatively,
- (b) logs may be directly compared with logs made by other tools (measuring the same rock property),
- (c) secondary calibrators may be established and used to check the behaviour of the tool as it ages.

The value of well logs is much increased when produced with tools which have been properly calibrated.

GAMMA RAY CALIBRATION

The Department of Mines SIE gamma ray tool was calibrated in the South Australia Department of Mines and Energy (SADME) AM4 Test Pit and 260 API was found to increase the count from 6 (background) to 72 counts per second(cps). The conversion factor from counts to API is therefore 3.94. The calibration run speed was 2 metres/minute with a full scale pen deflection of 100 cps and a time constant of 2 seconds. The calibration run was repeated several times without any variation (apart from normal statistical variations) from the initial result. A copy of the chart recorder output for one of these runs is shown in Figure 1.

GAMMA-GAMMA DENSITY CALIBRATION

The Department's SIE density tool was calibrated in three different test pits to give a total of seven different densities and six effective calibration densities (two densities, 2.19 and 2.2, are too close to be treated as separate calibration points). The tool was calibrated in each pit for four different configurations:

- | | |
|------------------|----------------------------------|
| (a) no spacers | source-detector separation 20 cm |
| (b) short spacer | source-detector separation 30 cm |
| (c) long spacer | source-detector separation 35 cm |
| (d) both spacers | source-detector separation 45 cm |

The densities of the first pit (AM4) are 1.86, 2.19, 2.00 and 3.06. The densities in the second pit (AM10) are 2.2 and 2.71. The density in the third pit (AM11) is 1.1. The 2.19 density zone in the first pit is the radioactive zone used for calibrating the gamma ray probe. It is therefore necessary to remove the effect of this radiation from the density tool detector reading in this zone. This was done by running the density

tool without the source. A count rate of 30 cps was measured in this zone and subtracted from the density count rate. In all cases the background count rate is negligible compared with the count rate due to the source.

The density tool is used with a bowspring which forces the source against the side of the borehole. Failure to keep the source in contact with the borehole wall will result in unreliable and essentially useless results. It was found that the bowspring exerted sufficient lateral force to prevent the tool descending except in the case of both spacers, the extra weight of which was sufficient to overcome the bowspring friction. This problem was overcome by taping the two springs of the bowspring assembly so that the tool would slide down the hole while the source remained in contact with the wall. It required several attempts before the correct taping procedure was established. If this problem is experienced in an ordinary borehole (where the density profile is both irregular and unknown) it may be practically impossible to tell for certain if the source is maintaining contact with the wall.

Figures 2 to 5 show the successful density calibration runs and Figure 6 shows the density detector (no source) through the radioactive zone. Figures 7 to 10 are the density calibration curves. If only one density run is planned it would be advisable to use both spacers if dense rocks are expected.

FLOWMETER CALIBRATION

SADME advice on calibrating the Department's SIE flowmeter tool is here presented (see fig. 11). A hose is attached to the inlet at the base of the vertical PVC tube and the bottom of tube filled with gravel to minimise turbulence. The tool is lowered into the tube from the top and suspended in the flow. The flow rate is determined by how long it takes the outflow to fill a vessel of known size.

SINGLE POINT S.P./RESISTIVITY CALIBRATION

SADME advice on calibrating the SIE single point S.P./Resistivity tool is here presented (see fig. 12). The power source for the calibration box should be a 1350 mV mercury battery (so that the voltage does not decay with age), 50 mV being presented to S.P. probes through a potential divider and +ve being grounded. When calibrating resistivity the battery is switched out of the circuit and zero, two, ten and fifty ohms presented between the probes. There is an additional resistance in the resistivity circuit due to cable resistance and it would be as well to check the value of this from time to time.

ACKNOWLEDGEMENTS

Thanks are due to the SADME geophysical borehole logging section, particularly Jim Alvey, for their generous assistance and advice and for allowing the Tasmania Department of Mines to use the test pits.

[18 October 1984]

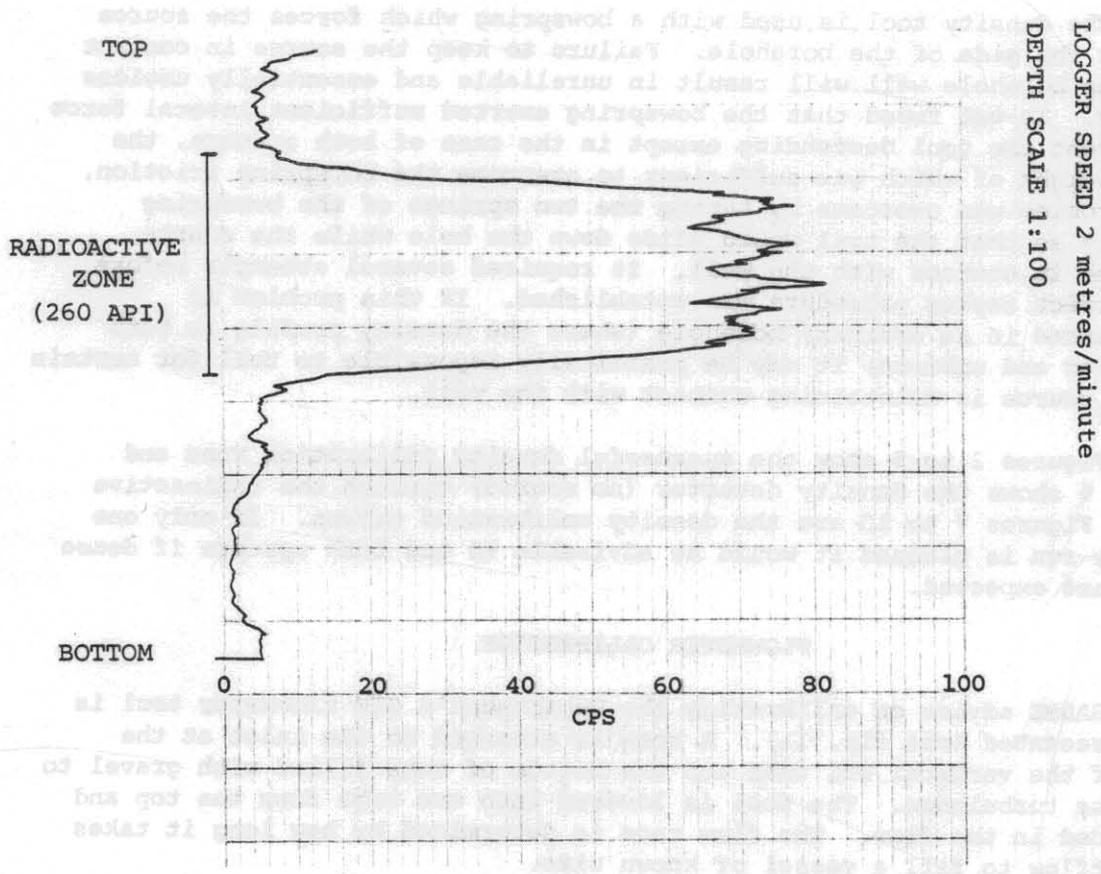
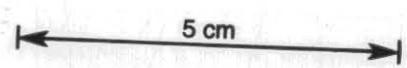


Figure 1. Natural gamma



Thanks are due to the BGRM geophysical borehole logging section, particularly Jim Kiley, for their generous assistance and advice and for allowing the Transvaal Department of Mines to use the test pits.

[18 October 1984]

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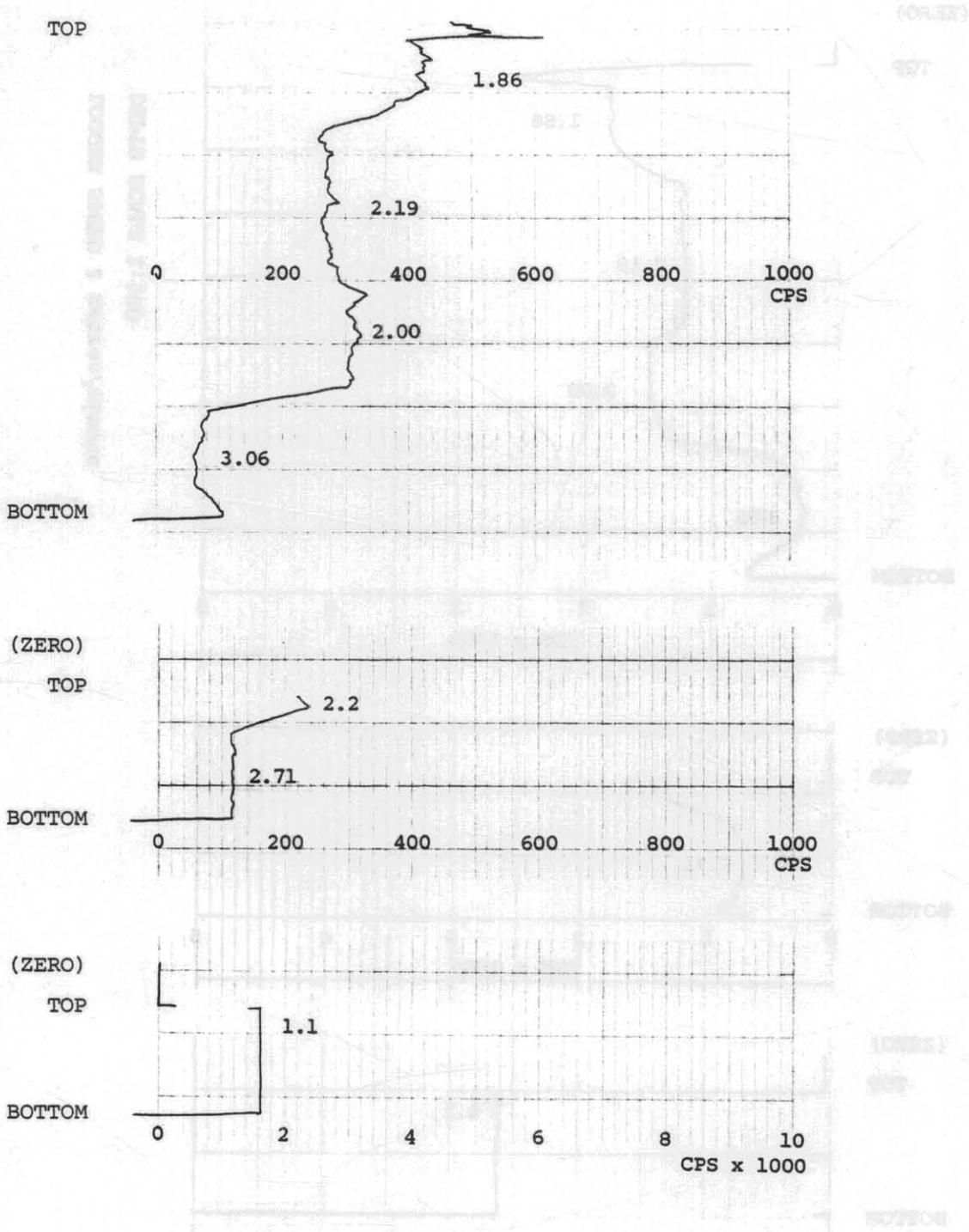


Figure 2. Both spacers.

5 cm

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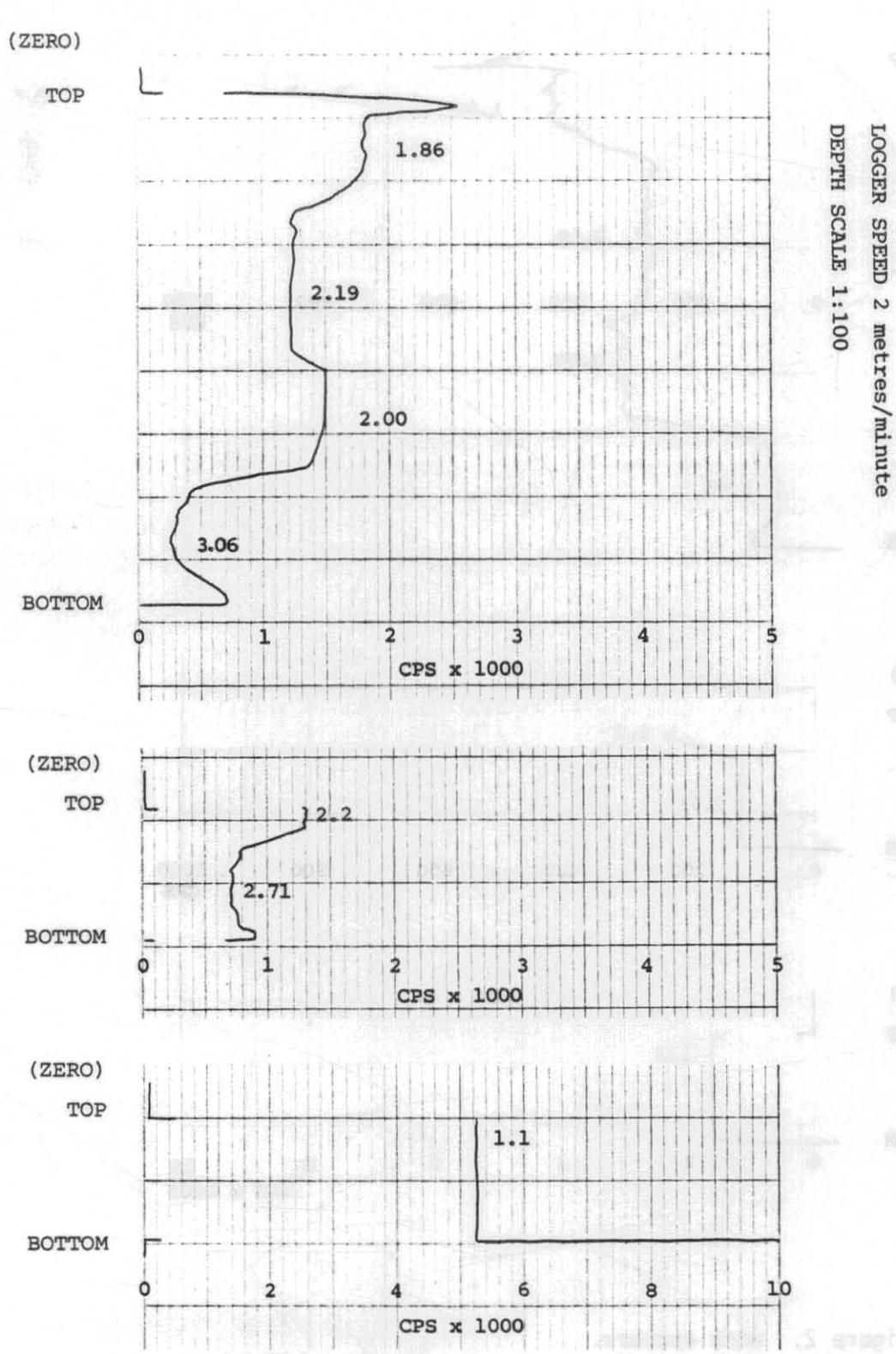
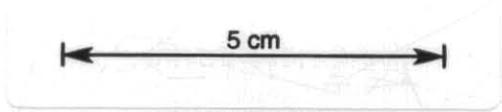


Figure 3. Long spacer.



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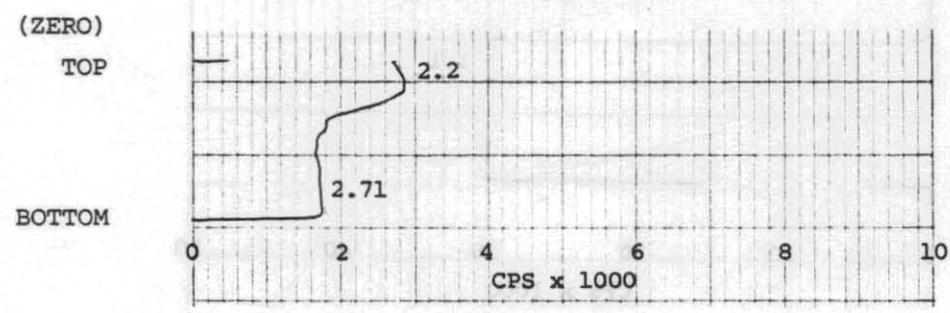
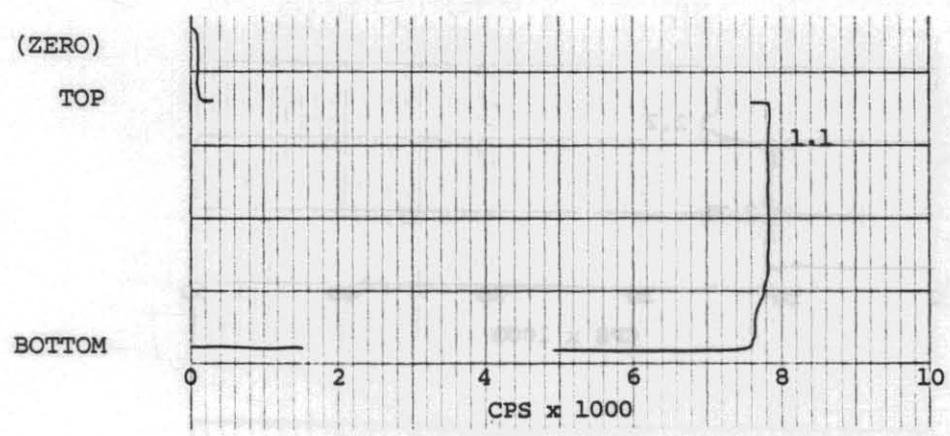
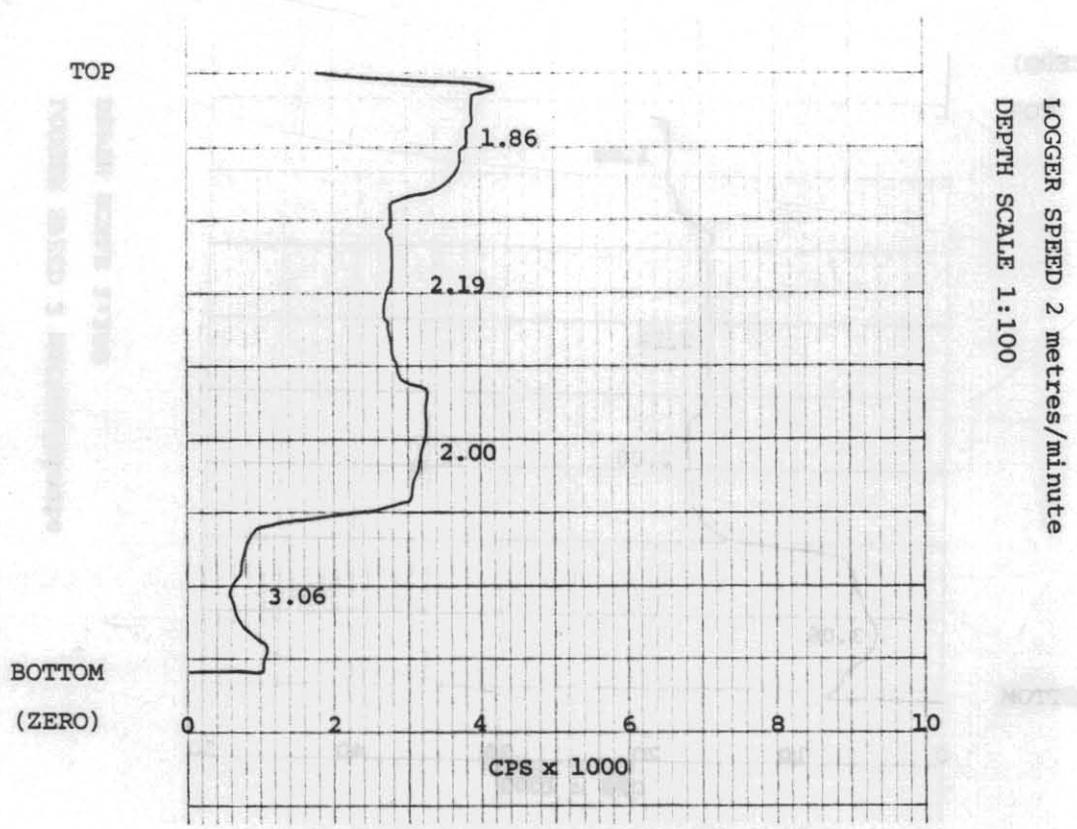
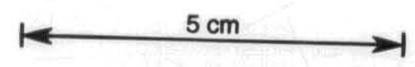


Figure 4. Short spacer.



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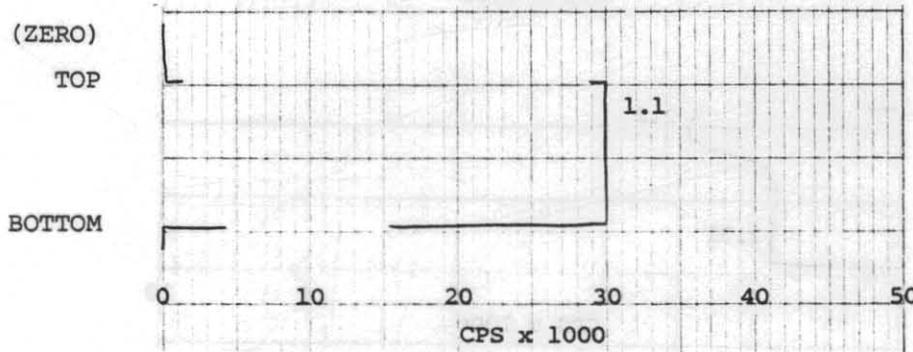
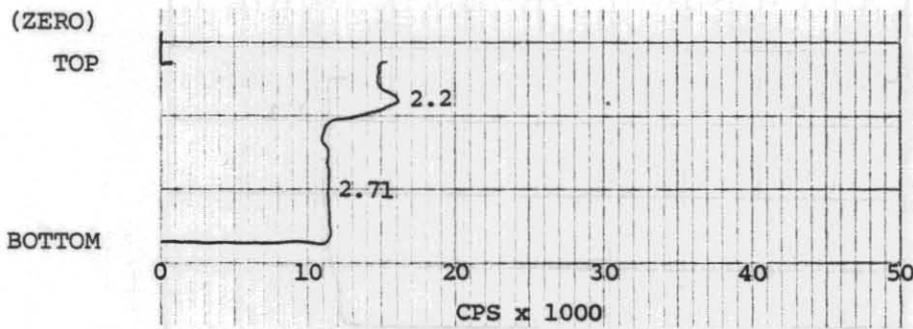
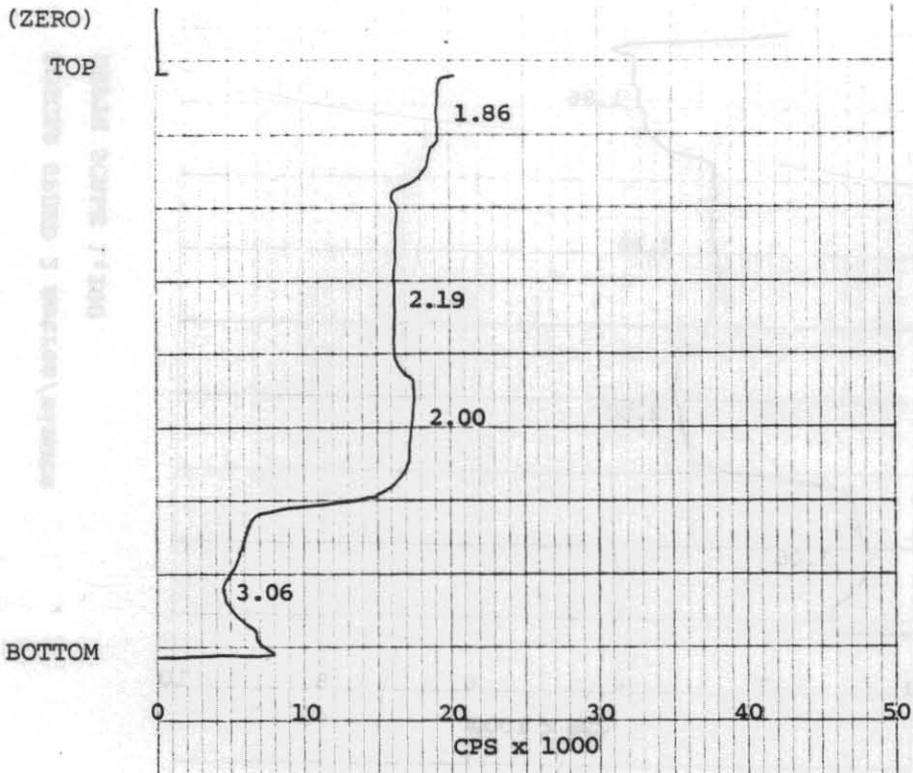


Figure 5. No spacers.

5 cm

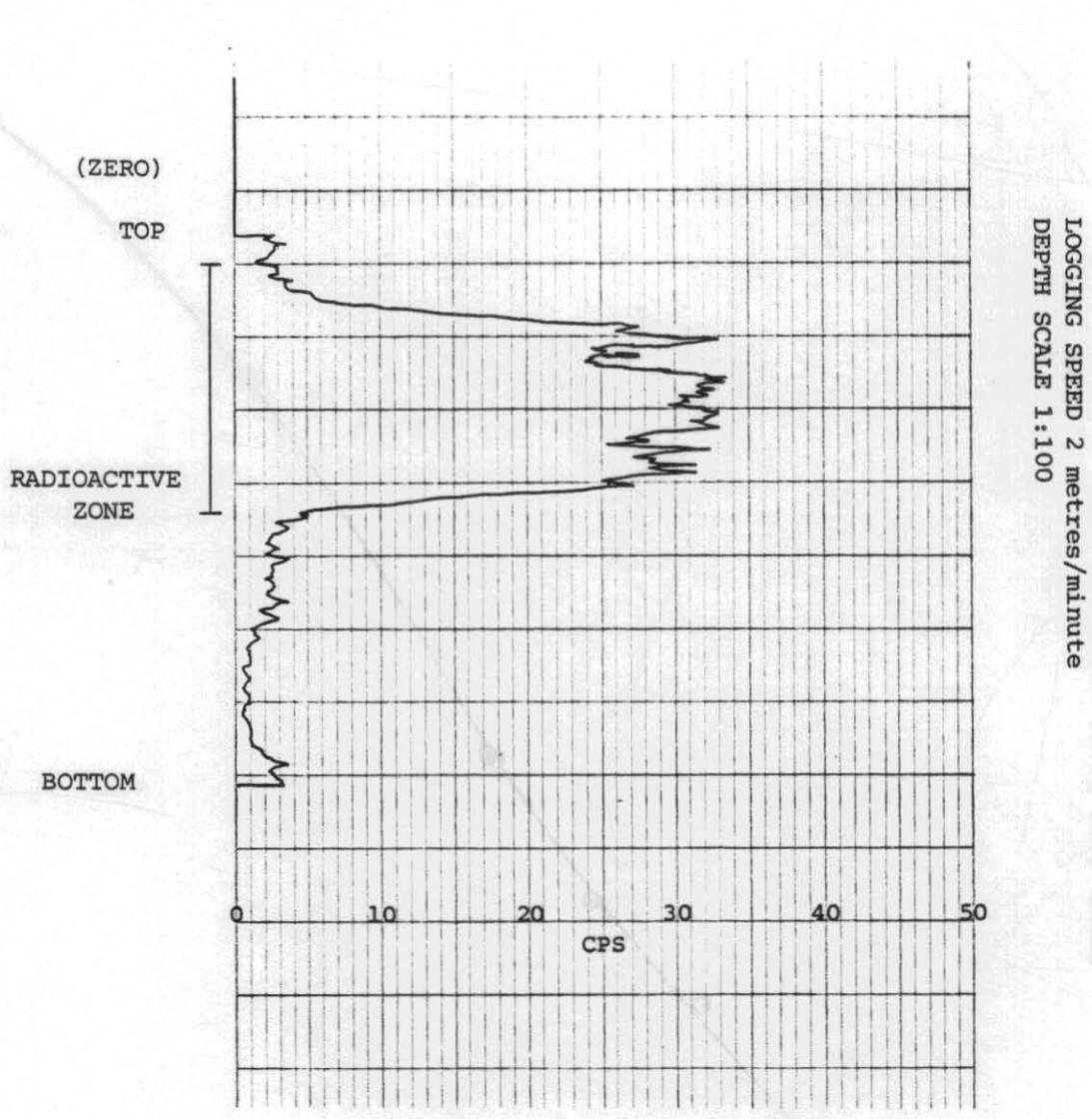


Figure 6. Density tool, no source

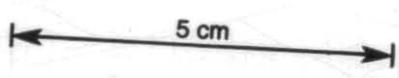
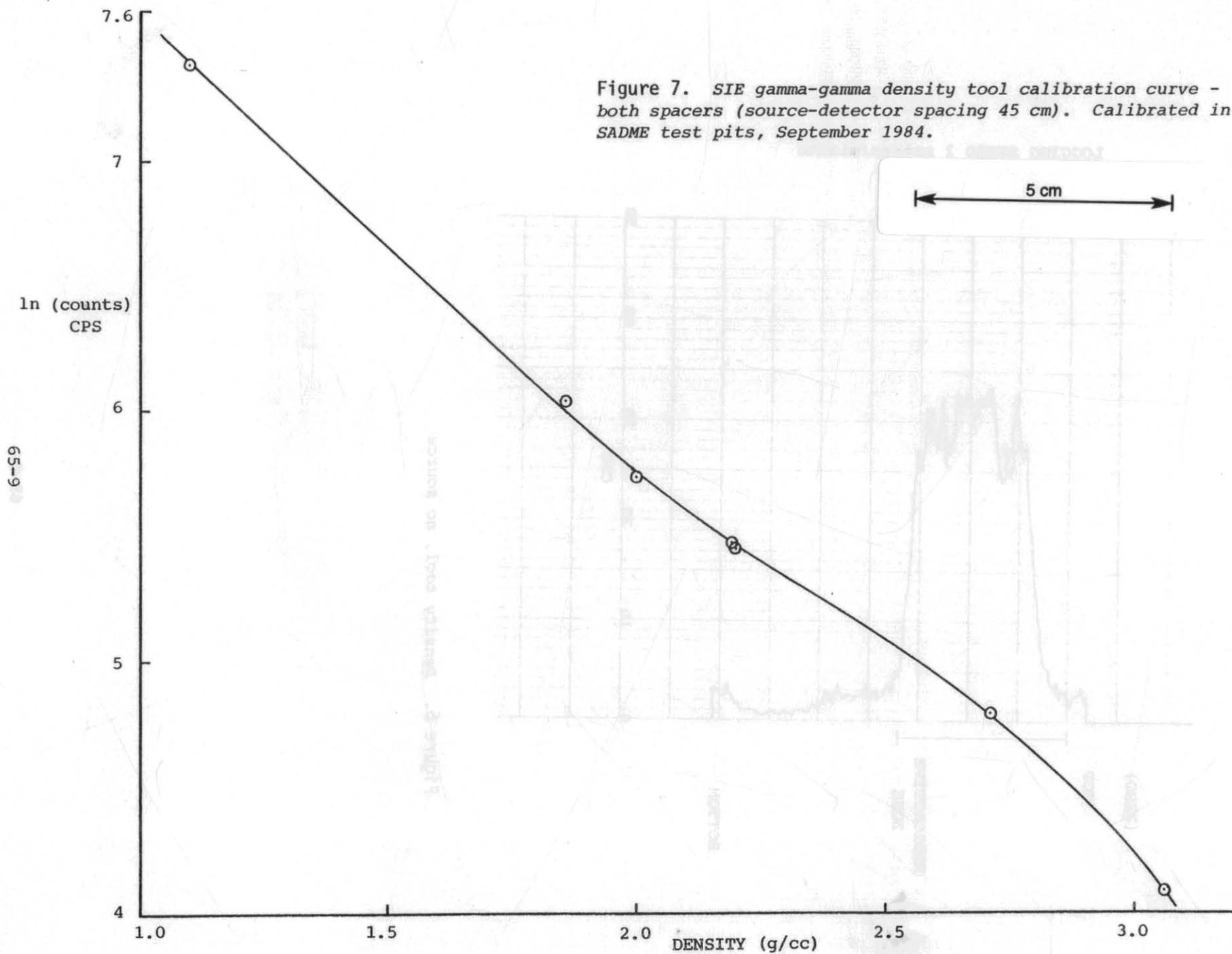
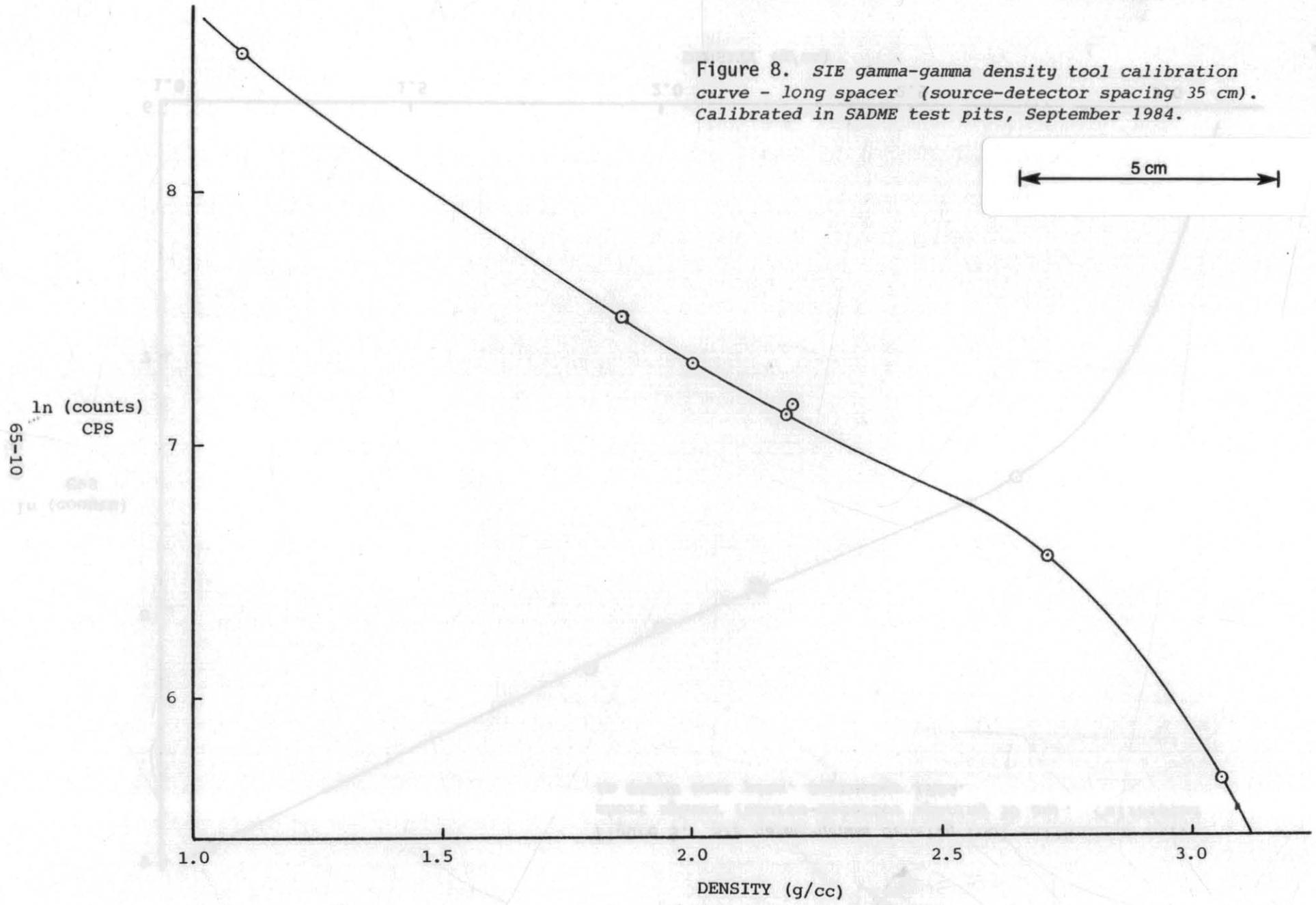


Figure 7. SIE gamma-gamma density tool calibration curve - both spacers (source-detector spacing 45 cm). Calibrated in SADME test pits, September 1984.



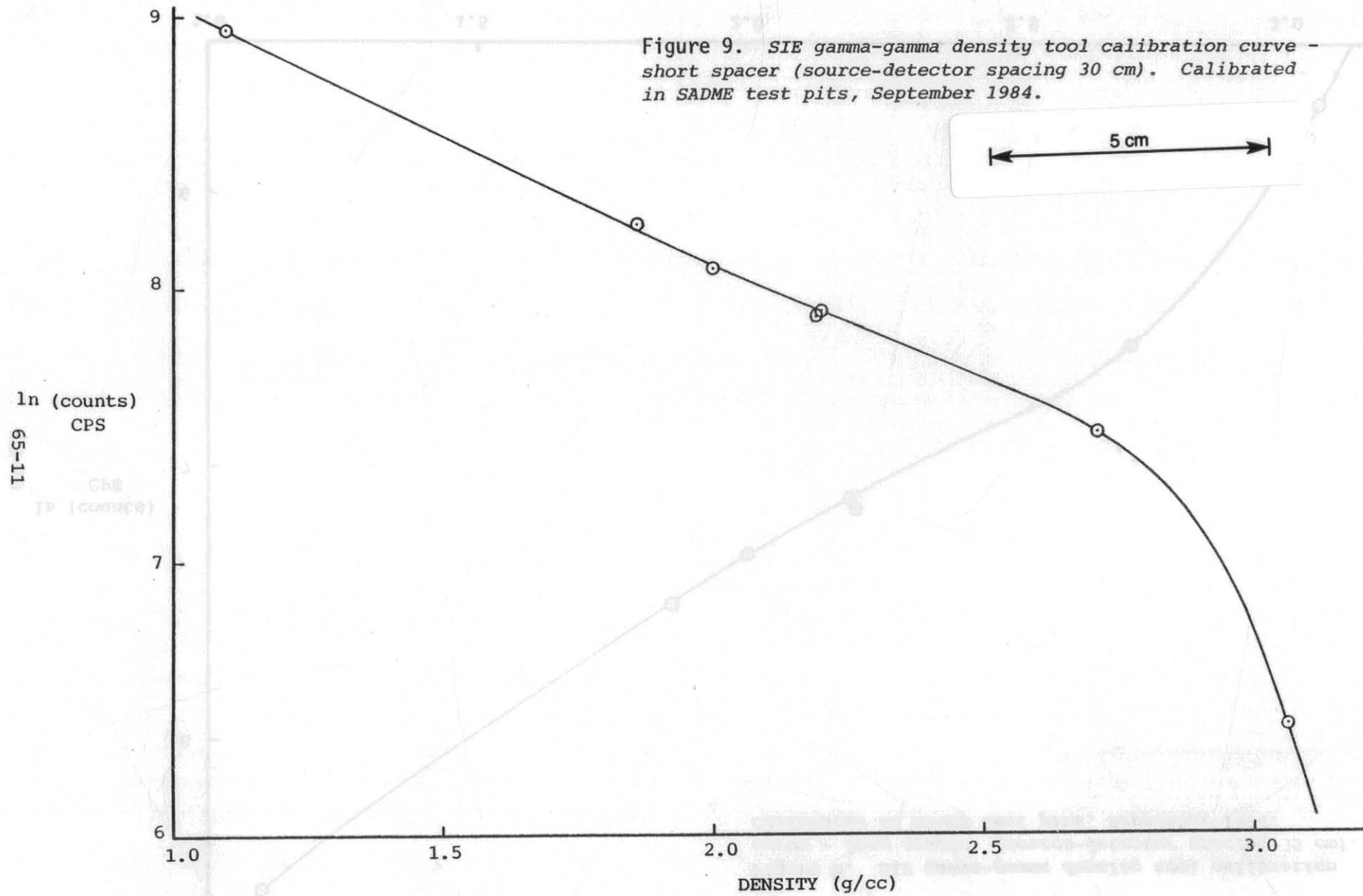
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Figure 8. SIE gamma-gamma density tool calibration curve - long spacer (source-detector spacing 35 cm).
Calibrated in SADME test pits, September 1984.



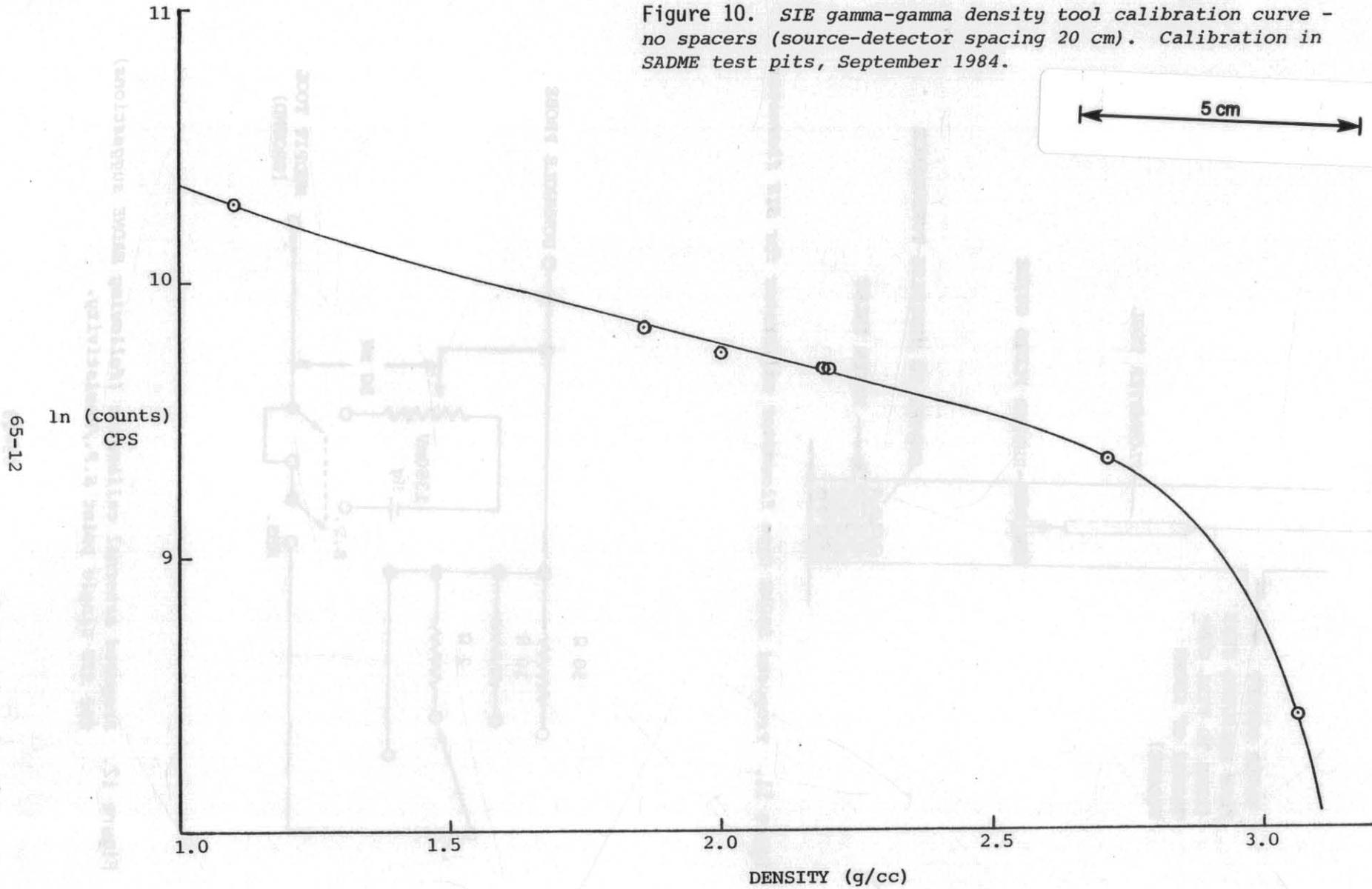
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Figure 9. SIE gamma-gamma density tool calibration curve - short spacer (source-detector spacing 30 cm). Calibrated in SADME test pits, September 1984.



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Figure 10. SIE gamma-gamma density tool calibration curve - no spacers (source-detector spacing 20 cm). Calibration in SADME test pits, September 1984.



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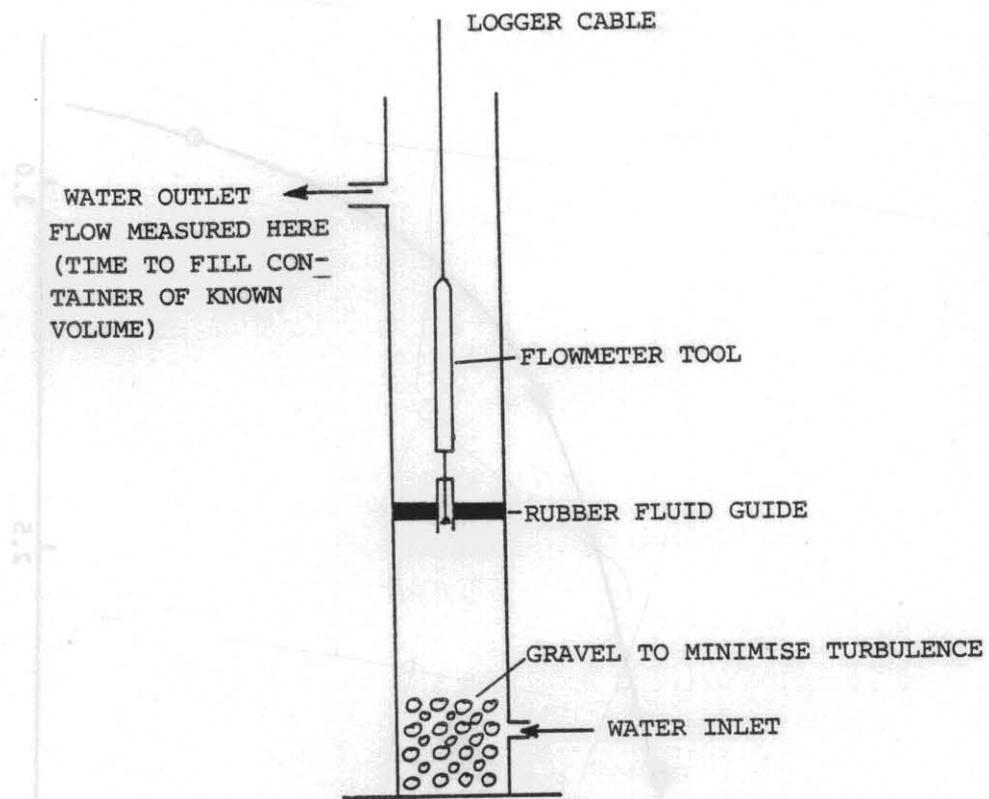


Figure 11. Proposed SADME type flowmeter calibrator for SIE flowmeter.

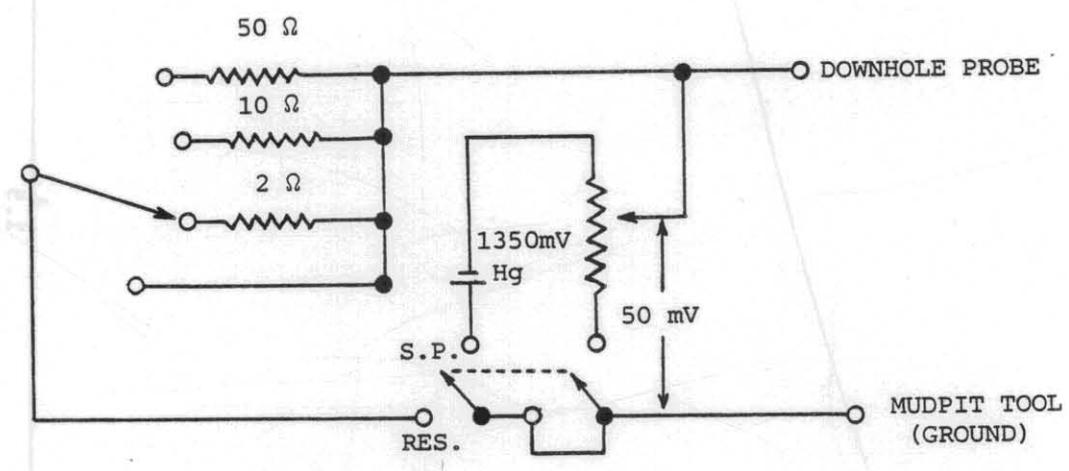


Figure 12. Proposed external calibrator (following SADME suggestions) for SIE single point S.P./Resistivity.

5 cm