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Revised Calibration for High
Pressure Electrical Resistance Cell*

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In 1960 a high pressure electrical resistance cell was developed in this laboratory,^{1/} utilizing the supported taper principle previously applied to an optical apparatus.^{2/} The calibration of the electrical cell was tenuous as it was based on some not accurately located phase transitions at low and moderate pressure plus a gross extrapolation of Bridgman's electrical resistance data for platinum.^{3/} Since that time a number of transitions have been located more accurately and x-ray diffraction techniques utilizing the tapered piston cell^{4/} have become available. A new calibration is presented here, based largely on x-ray diffraction work. This piston diameter and internal geometry of the x-ray cell can be made identical to the electrical cell, but the x-ray cell contains a layer of lithium hydride and boron, as well as platinum collimation, in addition to pyrophyllite, while the electrical cell contains only pyrophyllite, nevertheless, this calibration represents a considerable advance over the previous one. Much of the calibration data were taken with Al or Ag powder using the shock data of Rice et al.^{5/} interpolated to room temperature.^{6/} The 111, 200, 220, and 311 lines were utilized. Above 250-300 kilobars the dishing of the pistons made it impossible to obtain the 200 and 311 lines clearly. Above 400 kilobars only a few points were obtained for the 111 line. Data were also obtained for NaCl to over 200 kilobars. Applying Decker's calculated p-v values for NaCl,^{7/} we checked the Al and Ag data closely. MgO^{8/} also gave consistent results to 300 kilobars. The calibration is established as follows: The pressure is a linear function of applied force to 100 kilobars (and

substantially, linear to 130 kilobars). For higher pressures the fractional change of pressure (from 100 kilobars) versus fractional change in applied pressure is shown in Table I. This was obtained by taking the fractional change in pressure with the fractional change in applied force from the x-ray data to 400 kilobars and extrapolating primarily by assuming the relative pressure is a linear function of the logarithm of the relative applied force at pressures above 400 kilobars. (This condition holds quite well in the range 300-400 kilobars.) Typical curves for the old and new calibration appear in Fig. 1, and the low pressure region is expanded in Fig. 2. The absolute values vary from bar to bar of pyrophyllite, and with the machining and loading technique of the operator. Ranges are indicated in Fig. 1. From a single six inch bar of pyrophyllite sufficient pellets can be made for half a dozen low pressure calibrations and high pressure runs.

In Table II appear the "old" and "new" pressures obtained from typical calibration curves for a number of transitions. These are not presented as standards. It is of interest to note that the transitions in the low pressure region generally agree reasonably well with recent values obtained in other laboratories.

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TABLE I

Electrical Cell Calibration. Pressure versus applied pressure.* (Related to pressure necessary for 100 KBAR.)

Pressure (KBAR)	$P_{APP}/P_{100 \text{ KBAR}}$
100	1.00
130	1.32
150	1.60
200	2.50
250	3.80
300	5.60
350	8.20
400	12.00
450	17.70
500	26.00

TABLE II

Approximate Location of Transitions

	<u>Old</u>	<u>New</u>
Bi ✓	88	73-75
Fe ✓	133	110-113
Ba	144	118-122
Eu	150-160	122-130
Pb ✓	160	128-132
Rb	190	142-153
Cs* (max)	170-180	133-142
Ca* (max)	350-375	235-255
Rb* (max)	420-435	290-320
CdS* (max)	460	330-340
ZnS* (max)	550	410-420

*Maximum in resistance-pressure curve.

FIGURE CAPTIONS

Fig. 1 Old and new calibrations for high pressure electrical resistance cell--typical values.

Fig. 2 Calibration for low pressure region--typical values.

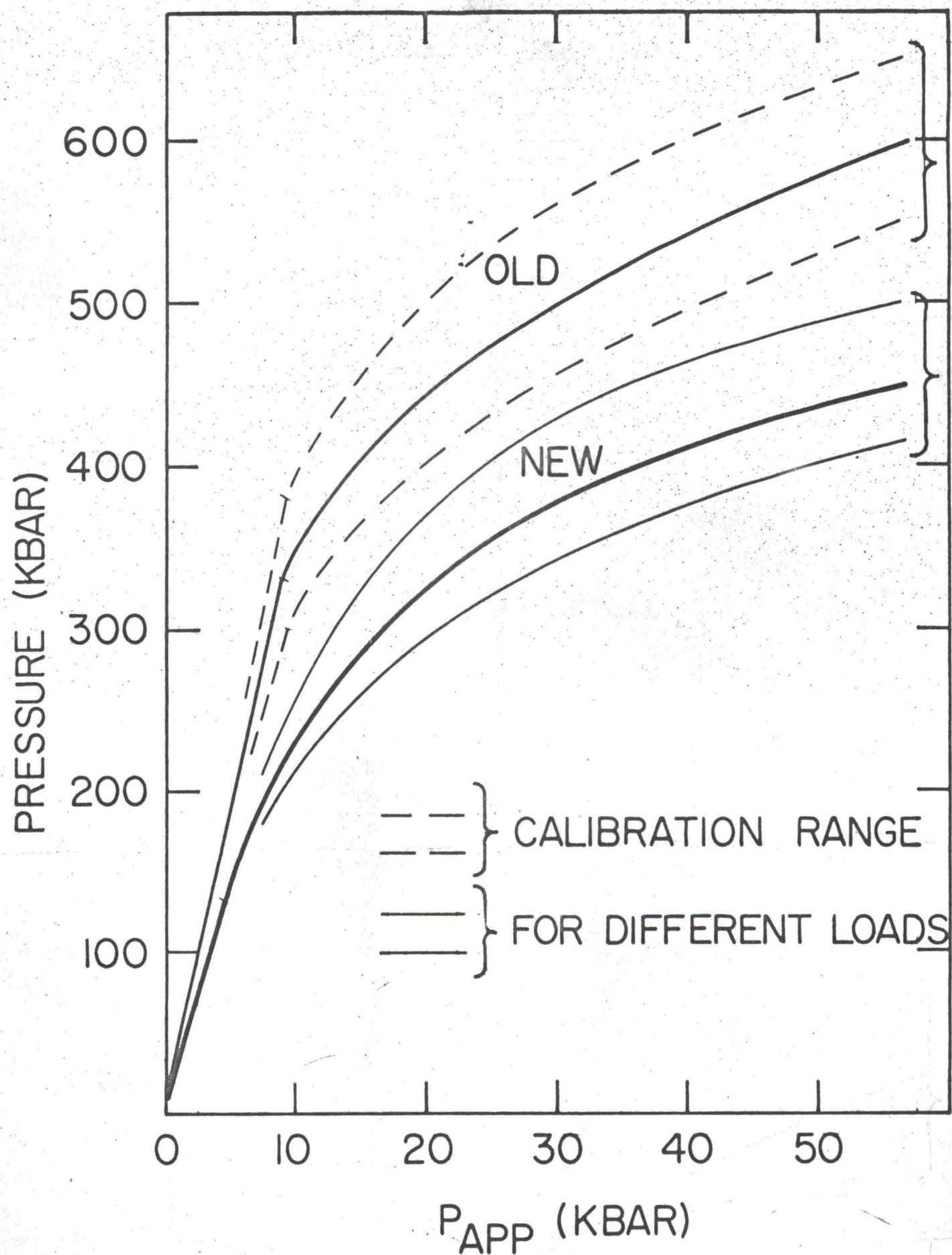


FIG 1 CALIBRATION FOR ELECTRICAL CELL

PRESSURE (KBAR)

OLD

NEW

$P_{APP.}$ (KBAR)

