TABLE 19. Temporary working pressure scale

Material	Pressure (kbar)	Temperature
Mercury	7.569	0 °C
Bismuth I–II	25.50	25 °C
Thallium II–III	36.7 ± 0.3	25 °C
Cesium II–III	42.5 ± 1.0	25 °C
Cesium III–IV	43.0 ± 1.0	25 °C
Barium I–II	55 ± 2	25 °C
Bismuth III–V	77 ± 3	25 °C
Tin	100 ± 6	25 °C
Iron $\alpha-\epsilon$	126 ± 6	25 °C
Barium	140	25 °C
Lead	120 − 160	25 °C

Above 30 kbar the shape of the manganin calibration curve is very uncertain. It is recommended that a specific manganin alloy with appropriate specifications be adopted for use in pressure measurements and also that a standard technique for winding and seasoning gages should be specified. This would insure pressure calibration of one percent without further intercomparison of each gage.

Using solid medium systems in the pressure range below 300 kbar, the NaCl scale based on the theoretical equation of state of NaCl is presently the best interpolation technique. It also has the capability of pressure calibration at elevated temperatures. In the 300 kbar region, the theoretical sodium chloride equation of state is in agreement with experimental compression data from shock measurements within about one percent. It is also important to note that the piston cylinder data is in agreement with the experimental sodium chloride equation of state data within one percent at 77 kbar.

Sodium chloride is recommended both in this report and by those in attendance at the Symposium on the Accurate Characterization of the High Pressure Environment as the most suitable substance for high pressure calibration by continuous change in the volume-pressure relationship. The theoretical 25 °C compression data is summarized in section 4 along with a value predicted at the fixed points from x-ray volume measurements coupled with the theory.

For many studies, the only interpolation device will be a calibration of the oil line pressure (press load) against a smoothed curve through the fixed points on the compression cycle. One serious limitation of the accuracy using this method is that the shape of the calibration curve is different for different types of high pressure apparatus. Various types of encapsulation materials and sample geometries further complicate this situation. In order to achieve a fairly accurate calibration using this method, great care must be taken with the details of the calibrant, sample chamber, and how the pressure experiment is carried out. Assuming proper care has been exercised in these items this type of interpolation instrument has a maximum accuracy of 2 to 3 percent and much less on an extrapolation. Although this is the least desirable type of interpolation gage for solid pressure transmitting systems, it is, however, generally the most practical and a fair reproducibility can be achieved in an isothermal experiment.

7.2. Dynamic Pressure Studies

Dynamic shock measurements provide another method of measuring pressure. Actually these measurements give the component of stress in the direction of motion of the shock front but the hydrostatic pressure can be estimated after making strength-of-material corrections. In order to compare with static work the temperatue in the shock front must be determined and then using some appropriate equation of state the results converted to pressure-volume data along an isotherm. Recent volumetric comparisons from various laboratories are in rather good agreement with each other, and in spite of the uncertainties in the corrections involved these results in general agree with static pressure measurements. Uncertainties in rate and nucleation effects attending phase transformations make this technique unsuited to highly accurate fixed point measurements and comparison with static fixed points is not reliable.

8. References

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