

EXPERIMENT IV

C_p/C_v RATIO

(S&G 5th, 6th, 7th & 8th eds. Experiment 3)

In this experiment the heat capacity ratio C_p/C_v , is obtained by the Sound Velocity method for three gases N_2 , CO_2 and Ar. The results are interpreted in terms of the contribution of the various degrees of freedom in the molecule to the heat capacity of the compound.

1. Safety

The gases used in this experiment are delivered from high pressure gas cylinders. Please read carefully in the following page the proper procedures to handle safely the pressure regulators. Wear your safety goggles at all times.

2. Experiment

The procedure is described in the text. A few hints are provided here.

1) **Fill the Kundt's tube.** In the present set-up, the Kundt's tube can be evacuated then filled with the relevant gas at a slightly positive pressure (10 to 40 kPa); the gas supply valve should be shut while taking measurements. Note that the dial gauge attached to the Kundt's tube reads the pressure *relative* to ambient pressure (*i.e.* zero reading corresponds to the local atmospheric pressure on the day of the experiment; this pressure should be recorded from the barometer available in the lab at some time during the laboratory session; do not forget to record the room temperature at regular interval during the session).

2) **Adjust the frequency generator.** Note that there is nothing magical about the frequencies of 1 kHz and 2 kHz, suggested in the text. As long as the value of the frequency is known, any frequency (almost) will do. With the present set-up choose frequencies which give the best response on the oscilloscope; the range of frequencies to chose from is actually limited by the frequency response of the microphone; the present microphone becomes "deaf" below 1000 Hz and above 4000 Hz. If the apparatus is working properly, it should be possible to locate the position of the nodes with an accuracy better than ± 1 mm.

3) **Repeat measurements for three gases.** Perform the experiment on N_2 , CO_2 and Ar. Be aware that for some frequencies, the corresponding set of measurements may have to be discarded as unreliable; mention and justify this clearly in your report. So, it is prudent to obtain measurements at a minimum of three different frequencies for each gas in order to be able to retain at least two "good" sets of measurements. Do not use He as suggested in the text.

Valuable information for the lab write-up may be found in the chapter V of S&G 6th, 7th and 8th eds. (chapter IV in 5th ed.).

Follow the points of discussion raised in the text book. With your report, provide your experimental data tabulated in the spreadsheet "`cpcv_results.xls`" (available from the course web site).

Notes about high pressure gas cylinders and gas pressure regulators

- 1) Gas cylinders must always be strapped to a solid support. The gases are stored at high pressure (100 – 150 atm). A fall might break the head of the cylinder turning it into a lethal projectile.
- 2) To deliver gas (see fig. 1 for typical gas regulator),
 - a. first insure that all the valves are shut, ie :
 - the cylinder main valve (item ②, located on top of the cylinder),
 - the diaphragm valve (item ③, located between the two gauges of the regulator - the diaphragm valve is shut when it is fully unscrewed) and
 - the small delivery valve (item ④).
 - b. Next, open the cylinder main valve (item ②); the regulator gauge closest to the cylinder (item ⑤) will show the pressure in the cylinder.
 - c. Then turn slowly clockwise the handle of the diaphragm valve (item ③) until the needle of the secondary stage gauge moves (item ⑥); keep turning to adjust to the desired pressure (for the present experiment a pressure of 2 to 5 psi is sufficient).
 - d. The gas flow may be controlled by opening or shutting gently the delivery valve (item ④).
- 3) When finished, close the cylinder main valve and vent the regulator by opening the delivery valve.

Before leaving the laboratory, please shut the main valve on all the gas cylinders.

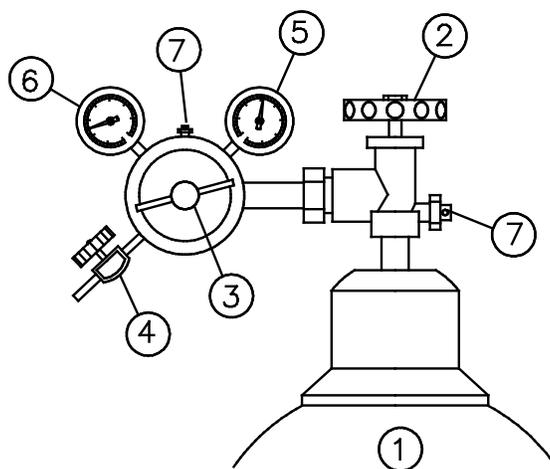


Fig. 1. Typical two-stage gas pressure regulator attached to a high pressure gas cylinder; (item 1) gas cylinder, (item 2) gas cylinder main valve, (item 3) regulator diaphragm valve to adjust delivery pressure, (item 4) delivery valve, (item 5) gauge showing pressure in the cylinder, (item 6) second stage gauge indicating delivering pressure, (item 7) safety pressure relief valves.

Chem 366W report check list

A report will not be accepted without all the items of this list checked. If a checked item is found missing in the report, the report will be automatically down-graded.

Student Name: _____

Report: Cp/Cv Ratio

Title page.

Correct title of the experiment

Student Name & student ID

Partner name (*if applicable*) _____

Date of performance of experiment

Abstract

Introduction and theory

Experimental

Changes from text description mentioned (*if applicable*)

Sample ID, ser no, stock solution ...etc recorded (*if applicable*)

Results

Results as Tables

Graphs

Size, at least ½ page

Axis labelled

Axis labels have units

Axis scales are sensible

Only significant figures

Uncertainties quoted

Raw data provided (*electronic form, if applicable*)

Calculations

Sample calculation provided

Error analysis

Sample error calculation provided

Discussion

Comments on results

Questions in text book and in manual answered

Comparison with literature value(s)

Conclusion

Blank Page