

# Specific Heat

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## Introduction to Specific Heat

The specific heat of a material is the quantity of heat energy needed to raise the temperature of a unit quantity of the material by 1 degree of temperature.<sup>1</sup> This 'unit quantity' may be expressed either as mass or volume. In the SI system, the preferred units are:

kilojoules [kJ] for energy

kilograms [kg] *or* cubic metres [m<sup>3</sup>] for quantity

kelvin [K] for temperature degree<sup>2</sup>

Gases always have *two* values of specific heat: one (as in this case) when the *pressure* of the gas is kept constant, and another (related) value for when the *volume* is kept constant.

## What is specific heat?

*Specific heat* is a measurement used in [thermodynamics](#) and [calorimetry](#) that states the amount of heat energy necessary to increase the temperature of an object by some unit of temperature. While different scales of measurement are sometimes used, specific heat typically refers to the amount of heat energy required to raise a single gram of some substance by one degree Celsius or by one [Kelvin](#) (one Kelvin is the same as one degree Celsius). It follows that if twice as much heat is added to a substance, its temperature should increase by twice as much. Specific heat is usually expressed in joules.

## Specific heat of gases

**The specific heat of a gas** is numerically equal to the amount of heat necessary to raise the [temperature](#) of unit mass of gas by 1°C. To raise the temperature of a unit mass of a gas 1°C, more heat will be required if the gas is kept at constant [pressure](#) than if it was kept at constant volume.

A unit of specific heat is J/kg K in the S.I. system

Experiments show that the specific heat of a particular material varies with temperature.

Specific heat is not a particularly crucial concept for calculation because numbers of molecules per unit mass change from material to material.

## Molar Specific Heat of Gases

Gases have two types of Molar specific heat, depending on whether or not the gas is allowed to expand when heated.

- When the [volume](#) of the gas is kept constant, its specific heat is called "molar specific heat at constant volume."
- When the pressure of the gas is kept constant, its specific heat is called "molar specific heat at constant pressure."

The molar specific heat capacity of a gas at constant pressure  $C_p$  is defined as the quantity of heat to raise the temperature of one mole of a gas through 1 K keeping its pressure constant.

Molar specific heat capacity of a gas at constant volume  $C_v$  is defined as the quantity of heat required to raise the temperature of one mole of a gas through 1 K keeping its volume constant.

The ratio of the specific heats  $\gamma = C_p/C_v$  is a factor in [adiabatic](#) engine processes and in determining the [speed of sound](#) in a gas. This ratio is  $\gamma = 1.66$  for an ideal mono atomic gas and  $\gamma = 1.4$  for [air](#), which is predominantly a diatomic gas.

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## Reference links:

- <http://www.en.wikipedia.org/wiki/Joule>
- <http://hyperphysics.phy-astr.gsu.edu/hbase/sound/souspe3.html#c1>
- <http://www.en.wikipedia.org/wiki/temperature>
- <http://www.wisegeek.com/what-is-calorimetry.htm>

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