

Thermodynamics+ Fluid

Chapter one

1) Definition in thermodynamics

Thermodynamics, working substance, pure substance, macroscopic and microscopic analysis, properties and state, phase, process, cycle, system, control volume, Energy, specific quantities, temperature and its measurements and scales, pressure and its measurements, volume, internal energy, enthalpy, work heat and their relationship, specific heat capacity.

1) Thermodynamics; is the branch of physical science that treats of various phenomena of energy and related properties of matter, especially of the law of transformation of heat into other form of energy.

2) Working substance ;all thermodynamic system require some working substance in order the various operation required of each system can be carried out.

3) Pure substance; the homogenous substance and its molecular structure do not vary

4) Phase; when a substance is of the same nature through its mass it is said to be in a phase. Matter can be exist in 3 phases (solid, liquid, gaseous) or single or two phase mixture.

5) Process ; when the state of a substance is change by means of an operation, or operation having been carried out on the substance, then the substance is said to have undergoes a process (ex. Expansion, compression of gas, conversion of water into steam)

1.6) Cycle ;if processes are carried out on a substance such that, at the end , the substance is return to its original state, then the substance is said to have been taken through a cycle

1.7) Macroscopic and Microscopic analysis

if the properties of a particular mass of a substance such as its pressure, volume and temperature are under investigation then the analysis is said to be macroscopic. But if an analysis is made in which the behaviour of the individual atoms and molecules of a substance are analysis , then the analysis is said to be microscopic analysis.

8) properties and state

In the macroscopic analysis of a substance any characteristic of the substance which can be observed or measured is called a property of the substance(Ex. Pressure, volume and temperature) and the property which is dependent upon the physical or chemical structure of the substance is called internal or thermostatic property .A knowledge of the various thermostatic properties of a substance defines the state of the substance and if the property or the properties are changed then the state are changed.

9) the system

All physical things in nature have some form of boundary where shape in general identifies it as the object it was. Inside its boundary there are certain things with particular function to carry out this inside arrangement is called system. The boundary need not to be fixed, for example, a mass of a gas(the system) may be expand and hence the boundary in this case will modify and the interaction will occur with the surrounding .If the mass of the system remains constant then the system is said to be a closed system.

if the mass of the system changes, or is continuously changing the system is said to be open system. Air compressor is an example of open system and steam power plant as closed system.

(1.10) the physical properties of the working substance

a) the mass; the mass of the body is the absolute quantity of matter in it, its unit is in kg.

b) weight; the weight of the body means the attraction force of gravity on it, its unit is in Newton

weight = mass \times gravity acceleration ($N = kg \cdot m/sec^2$)

the body of 6 kg will have a weight of $6 \times 9.8 N = 58.8 N$

c) Energy; is defined as the capacity of a body or substance to do work, its unit is in W or J/sec

d) Work; the result of moving a force through a distance, its unit is in (N.m) or Joule (J)

11. Specific quantities; is the properties of a unit mass of a substance. Specific volume means volume per unit mass, specific energy means energy per unit mass of the system.

12. Temperature and its measurement

The temperature of a body is its thermal state considered with reference to its ability to communicate heat to other bodies

A scale of temperature is an arbitrary thing. The Fahrenheit and Celsius (Centigrade) Scale are based on the ice point and the steam (boiling) point for water at 1 atm. pressure.

$$T(C) = \frac{5}{9}(T(F) - 32)$$

Thermodynamics required the use of absolute temperature which is measured from the absolute Zero.

$$\text{Absolute Zero}[F] = -459.67 \quad F = -273.16 \quad C$$

$$\text{Rankine Deg} = T(F) + 459.67 \quad (\text{absolute temp. in English unit})$$

$$\text{Kelvin Deg} = T(C) + 273.16 \quad (\text{absolute temp. in SI unit})$$

Many methods have been developed for measuring temperature. Most of these depend on measuring some physical property of a working material that varies with temperature.

One of the most common devices for measuring temperature is the glass thermometer.

This consists of a glass tube filled with mercury or some other liquid, which acts as the working fluid. Temperature increase causes the fluid to expand, so the temperature can be determined by measuring the volume of the fluid. Such thermometers are usually calibrated so that one can read the temperature simply by observing the level of the fluid in the thermometer. Another type of thermometer that is not really used much in practice, but is important from a theoretical standpoint, is the gas thermometer.

Other important devices for measuring temperature include:

- Thermocouples
- Thermistors
- Resistance Temperature Detector (RTD)
- Pyrometer
- Langmuir probes (for electron temperature of a plasma)
- Infrared
- Other thermometers