76. Scale Trap

77. Spray Pond

78. Thermal Bulb

79. Thermostat (Remote Bulb)

80. Valves

80.1 Automatic Expansion

80.2 Compressor Suction Pressure Limiting, Throttling Type (Compressor Side)

80.3 Constant Pressure, Suction

80.4 Evaporator Pressure Regulating, Snap Action

80.5 Evaporator Pressure Regulating, Thermostatic Throttling Type

80.6 Evaporator Pressure Regulating, Throttling Type (Evaporator Side)

80.7 Hand Expansion

80.8 Magnetic Stop

80.9 Snap Action

80.10 Suction Vapor Regulating

80.11 Thermo Suction

80.12 Thermostatic Expansion

80.13 Water

81. Vibration Absorber, Line

## IDENTIFICATION OF PIPING SYSTEMS BY COLOR

The color scheme for identification of piping systems, based on material carried, as listed in the following table and shown in Fig. 1, is reprinted from Part V, Fourth Edition, of the Engineering Standards of the *Heating, Piping and Air Conditioning Contractors National Association.*[1]

| Class | Color |
|---|---|
| F—Fire-protection | Red |
| D—Dangerous materials | Yellow or Orange |
| S—Safe Materials | Green (or the achromatic colors, white, black, gray or aluminum) |
| and, when required | |
| P—Protective materials | Bright blue |
| V—Extra valuable materials | Deep purple |

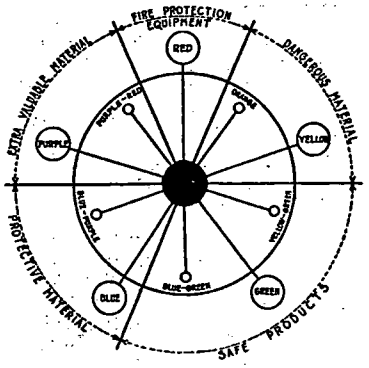



FIG. 1. MAIN CLASSIFICATION BY COLOR

[1] See Scheme for Identification of Piping Systems, A13-1928, *American Standards Association*

CHAPTER 3

# THERMODYNAMICS

Mass and Energy Balances; Thermodynamic Properties of Moist Air; Formulas and Tables; Thermodynamic Properties of Water, Formulas and Tables; Degree of Saturation; A.S.H.V.E. Psychrometric Chart; Solution of Air Conditioning Problems by Use of Tables and Psychrometric Chart; U. S. Standard Atmosphere

THERMODYNAMICS is that branch of natural science which deals with energy and its transformations into various forms. In this chapter the discussion will be limited to thermodynamics as it affects the arts of heating and air conditioning. This will necessarily presume some knowledge of the fundamentals of the science on the part of the reader who may also find it desirable to refer to a standard text on the subject, preferably one published after 1930.

## MASS AND ENERGY BALANCES

The First Law of Thermodynamics is a statement of the Principle of Conservation of Energy. It may be stated as follows: *The energy added to a system is equal to the increase or decrease of the energy stored in the system, plus the energy which leaves the system.* For a completely contained, or non-flow system, this may be restated as: The heat added to a non-flow system is equal to the change in the internal energy of the system, plus the work done by the system.

$$ {}_1q_2 = U_2 - U_1 + w \qquad (1)$$

For a constant pressure process

$$ {}_1q_2 = H_1 - H_2 \qquad (2)$$

*where*

${}_1q_2$ = energy added between points 1 and 2.
U = internal energy of system.
w = work done by system.
H = enthalpy of system.

Subscripts 1 and 2 refer to sections of the system between which a change takes place.

For engineering problems, a more important application of the First Law is its use in cases in which, in addition to energy, one or more fluids are crossing the boundaries of the system. The most simple of these is the steady flow system, in which the rates of energy and mass flow across the boundaries of the system are constant, and no mass or energy is stored or released by the system.

Consider a system as illustrated in Fig. 1. The fluid crossing the boundaries of the system carries with it potential energy by reason of its elevation above some convenient datum, kinetic energy by reason of its