1. BASIC PRINCIPLES OF ELECTRICITY

CONTENTS

ANIXTER

1. BASIC PRINCIPLES OF ELECTRICITY

1.1 Electricity

Electricity, simply put, is the flow of electric current along a conductor. This electric current takes the form of free **electrons** which transfer from one atom to the next. Thus, the more free electrons a material has, the better it conducts. There are three parameters involved in the electrical equation: the volt, the ampere, and the ohm.

1.2 The Volt

The pressure that is put on free electrons that causes them to flow is known as **electromotive force** (**EMF**). The volt is the unit of pressure, i.e., the volt is the amount of electromotive force required to push a current of one ampere through a conductor with a resistance of one ohm.

1.3 The Ampere

The ampere defines the flow rate of electric **current.** For instance, when one **coulomb** (or 6×10^{18} electrons) flows past a given point on a conductor in one second, it is defined as a current of one ampere.

1.4 The Ohm

The ohm is the unit of **resistance** in a conductor. Three things determine the amount of resistance in a conductor: its size, its material, e.g., copper or aluminum, and its temperature. A conductor's resistance increases as its length increases or diameter decreases. The more conductive the materials used, the lower the conductor resistance becomes. Conversely, a rise in temperature will generally increase resistance in a conductor.

1.5 Ohm's Law

Ohm's Law expresses the correlation between electric current (I), voltage (V), and resistance (R) in a conductor. Ohm's Law can be expressed as:

$$V = I \times R$$

Where: V = volts
I = amps
R = ohms

1.6 Ampacity

Ampacity is the amount of current a conductor can handle before its temperature exceeds accepted limits. These limits are given in the National Electrical Code (NEC), the Canadian Electrical Code, and in other engineering documents such as those published by the Insulated Cable Engineers Assocation (ICEA). It is important to know that many external factors affect the ampacity of an electrical conductor and these factors should be taken into consideration before selecting the conductor size.

1.7 Electrical Systems

The most widely used medium voltage (5 to 35 kV) alternating current (AC) electrical distribution systems in North America are illustrated below:

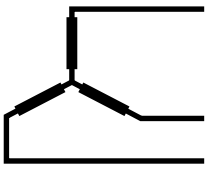

**Figure 1.1–Three phase wye (star)
Three wire**

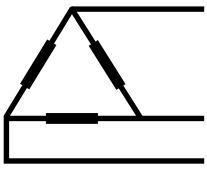

**Figure 1.2–Three phase delta
Three wire**

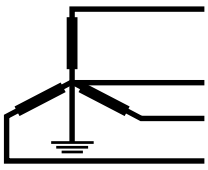

**Figure 1.3–Three phase star
Four wire, grounded neutral**

Typical low voltage systems are illustrated below:

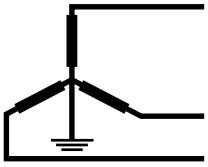

**Figure 1.4–Three phase wye (star)
Three wire, grounded neutral**

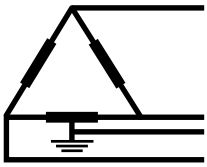

**Figure 1.5–Three phase delta
Four wire, grounded midpoint**