Difference between 220V systems and 110V systems

The line voltage differences have a significant impact on the occurrences of electrical fires. This is due to the fact that in the 100V-127V electrical systems the electrical current is twice the electrical current in a 220V-240V system that supplies the same electrical power.

Mathematically speaking:

(1) $P = V * I$

Where:

P = the electrical power in Watts per second dissipated by an electrical element

V = the electrical voltage in Volts over the electrical element

I = the electrical current in Amperes per second, the current flowing through the electrical element.

The voltage across any element in an electrical network is

(2) $V = I * R$

Using (2) in (1) we get

(3) $P = I^2 * R$

As the voltage in the 100V to 127V is about half the voltage in the 220V to 240V systems, the electrical currents in the 100V to 127V systems should be doubled in order to supply the same Power (P) to each load.

Many electrical faults are caused by temperature rise over a resistive-point in the electrical-wiring of the facility. This resistance is formed, many times, by corrosion, micro arcing and loose connections. We call it “Parasitic-Resistance”.

Now let us have a look at the voltage across that parasitic-resistance.

The voltage across the parasitic-resistance of an electrical circuit is sometimes referred to as “I^2R losses”. The term “losses” is used because the voltage across that parasitic-resistance causes the voltage that reaches the electrical load to be lower (and therefore less effective) than the voltage that entered the electrical system.

When comparing I^2R losses in 100V to 127V systems against I^2R losses in the 220V to 240V systems, we can see that as I (the electrical current) in the 100V to 127V systems is double than I in the 220V to 240V systems - I^2 is 4 times larger. In formulas:

(4) $I_{110} = 2 * I_{220}$

Therefore:

(5) $(I_{110})^2 = 2^2 * (I_{220})^2 = 4 * (I_{220})^2$

This means that the value of R that will generate a specific I^2R loss in a 100V to 127V system will be 1 / 4 of the R in a 220V to 240V system with the same I^2R loss.

IN cases where the R of the I^2R-loss is a resistive point that develops due to aging of the electrical wiring which means that in 100V to 127V systems the resistive point reaches a fire ignition point in a significantly shorter aging time.