tescometering.com

Intro to Self-Contained Metering

PREA

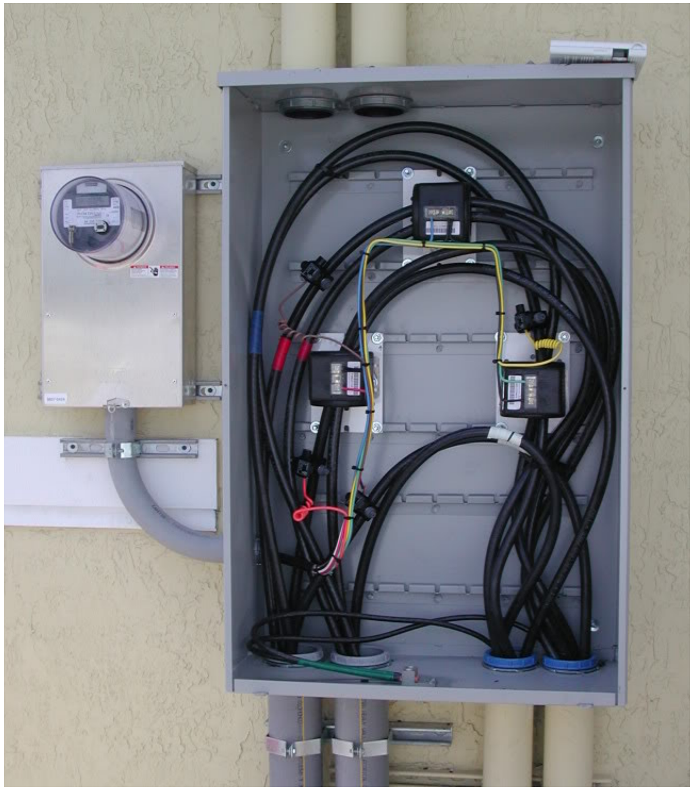
March 5, 2024 8:15 AM – 9:30 AM

Perry Lawton, TESCO
Michael Mayer, CB Associates

Pennsylvania Rural Electric Association

TOPICS WE WILL BE COVERING

- The Basics- Differences Between Self Contained and Transformer or Instrument Rated Meter Sites
- Transformer Rated Meter Forms
- Test Switches and CT's
- Blondel's Theorem and why this matters to us in metering
- Meter Accuracy Testing in the Field
- Checking the Health of your CT's and PT's
- Site Verification and not just meter testing



SELF CONTAINED METERING

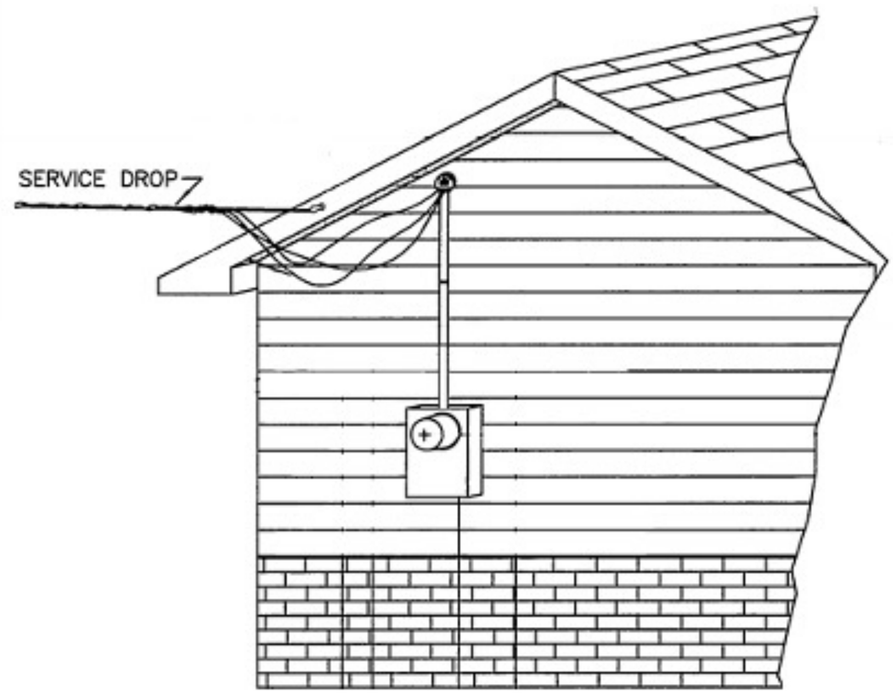
•Typically found in residential metering

•Meters are capable of handling the direct incoming amperage

•Meter is connected directly to the load being measured

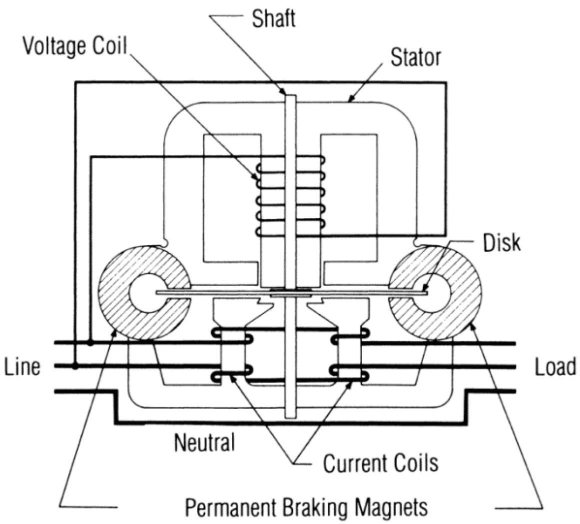
•Meter is part of the circuit

•When the meter is removed from the socket, power to the customer is interrupted



tescometering.com

METERS THROUGH THE YEARS



Induction Meter

Duncan Meter

Meter from 1960's

Sensus

Landis+Gyr

Aclara

Honeywell

Itron

Meter from 80's and 90's

2000 to Present

Ohms Law

Voltage = Current times Resistance

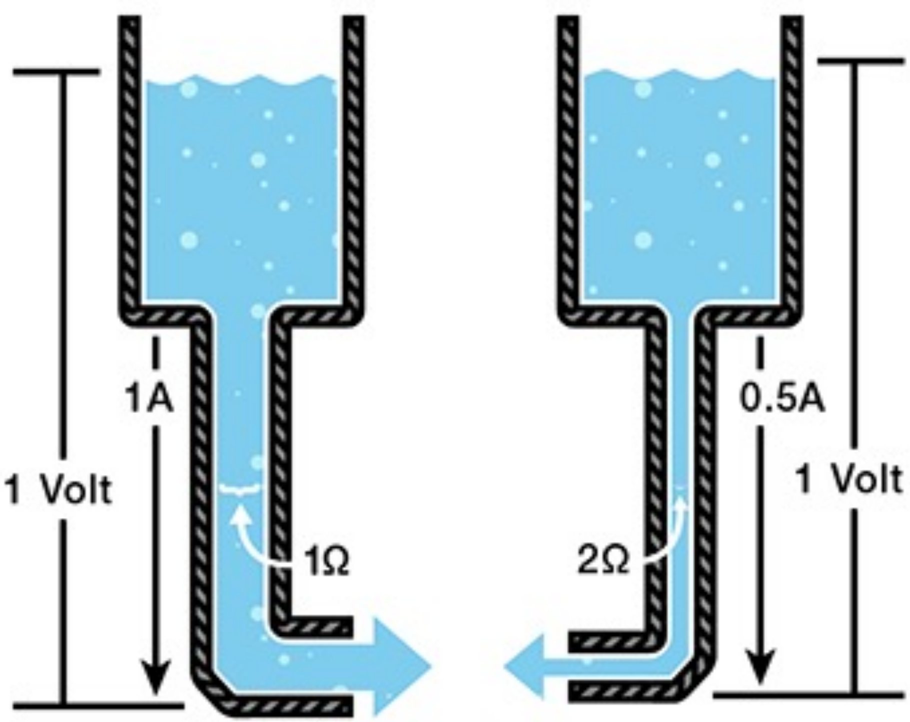
V = I X R

THE MOST USEFUL AND THE MOST FUNDAMENTAL OF THE ELECTRICAL LAWS

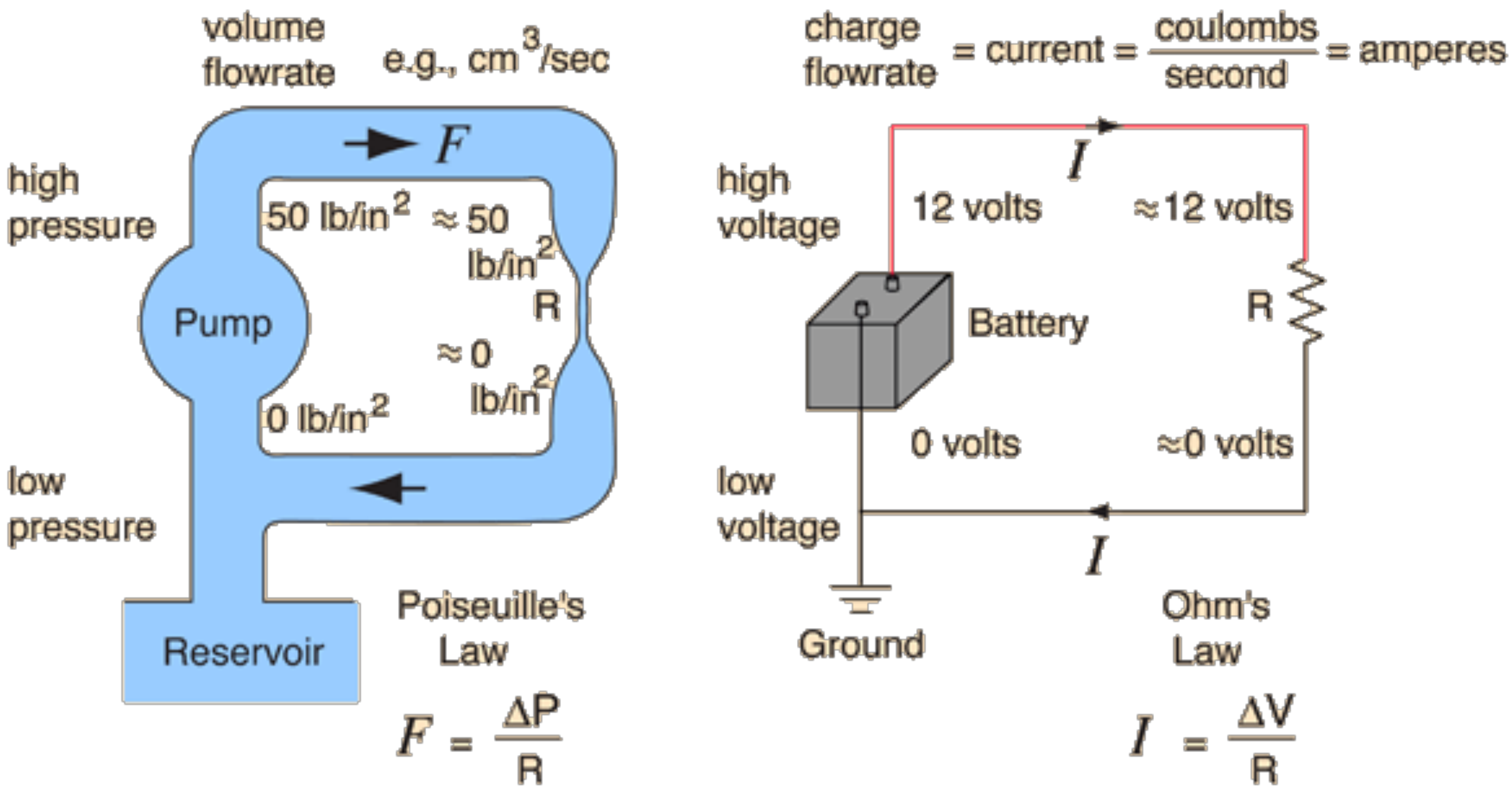
Comparing Electricity to Water flowing from a hose

- Voltage is the equivalent of the pressure in the hose
- Current is water flowing through a hose (coulombs/sec vs gal/sec). The water in a system is the “charge” (coulombs)
- Impedance(Resistance) is the size of the hose. The nozzle would provide a change in resistance.
- Power is how fast water flows from a pipe (gallons per minute vs kilowatts). Power is a rate of energy consumption

Basic Concepts: Electricity and Water



Practical Electricity



- Ohms Law Examples
  - If V = 20 volts and I = 5 amperes what is the resistance?

    R = V / I = 20 / 5 = 4 ohms
  - If R = 20 ohms and V = 120 volts what is the current?

    I = V / R = 120 / 20 = 6 amps
  - If I = 10 amperes and R = 24 ohms what is the voltage?

    V = I x R = 10 x 24 = 240 volts

  - Problem: If V = 240 volts and R = 6 ohms what is the current?

    I = V / R = 240 / 6 = 40 amps

Power is Voltage x Current

- Power = Voltage x Current = V x I = I^2R = V^2/R

Voltage (volts):	Current (amps):	Resist.(ohms):	Power:
V=I x R	I = V/R	R = E/I	P=VxI
V=P/I	I = P/V	R = P/I^2	P=I^2xR
V=√(P x R)	I = √(P/R)	R = V^2/P	P= V^2/R

Basic Electrical Laws

- Power = Voltage x Current = V x I = I^2R = $V^{2/}R$
  - If V = 20 volts and I = 8 amperes what is the power?

    P = V x I = 20 x 8 = 160 watts
  - If R = 5 ohms and V = 120 volts what is the power?

    P = $V^{2/}R$ = 120 x 120 / 5 = 2880 watts
  - If I = 10 amperes and R = 20 ohms what is the power?

    P = I^2R = 10 x 10 x 20 = 2000 watts

1 kilowatt (kW) = 1,000 watts

1 megawatt (MW) = 1,000,000 watts

Basic AC Theory
What is VA?

Power was measured in Watts. Power does useful work. The power that does useful work is referred to as "Active Power."

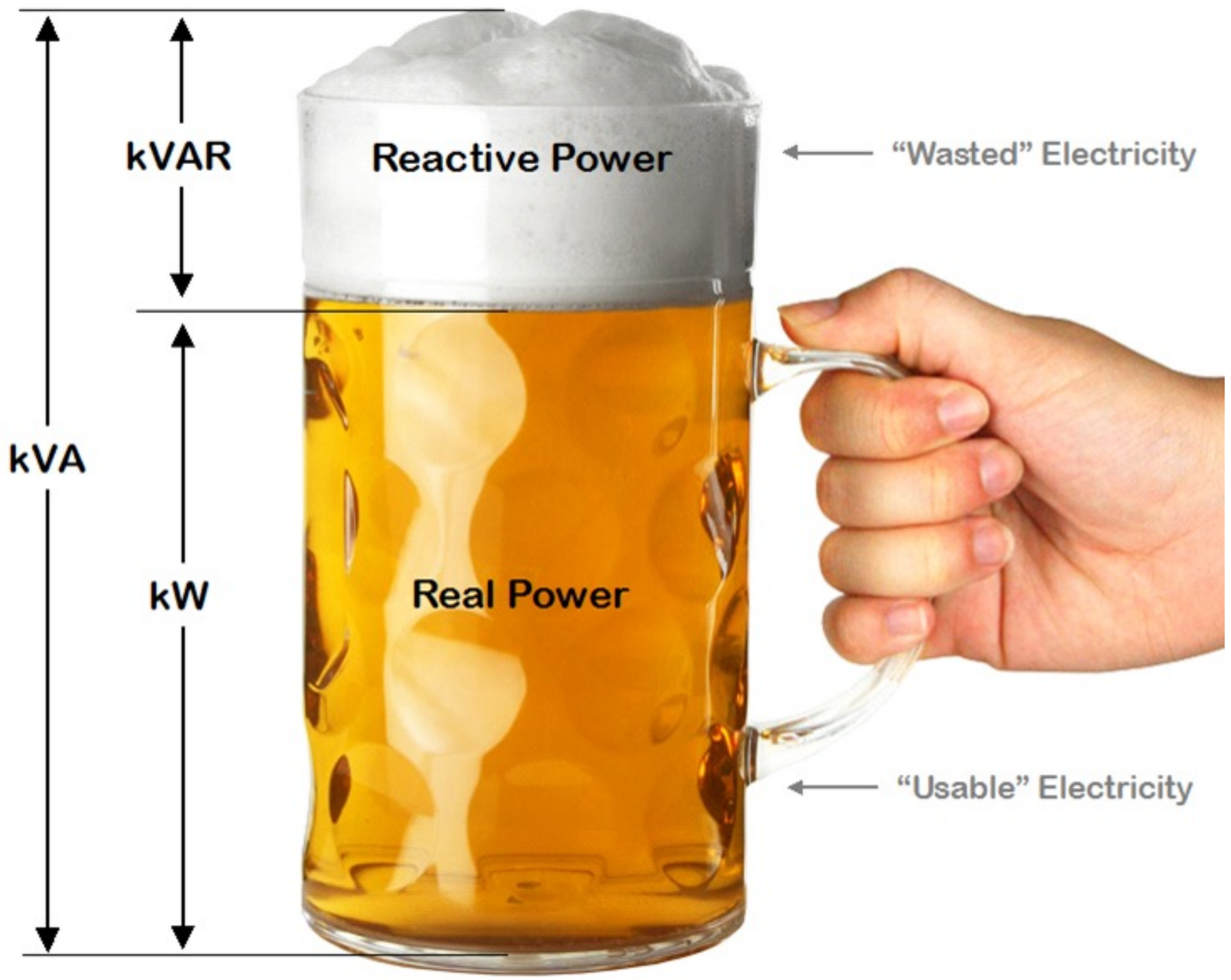
VA is measured in Volt-Amperes. It is the capacity required to deliver the Power. It is also referred to as the "Apparent Power."

Power Factor = Active Power / Apparent Power

VA = E x I

PF = W/VA

Basic AC Theory
What is VA?



Basic Meter Math
Power – VA

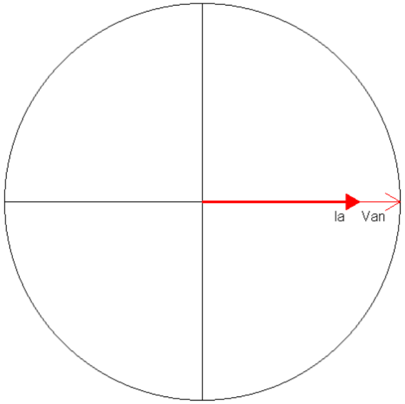
For a 120 Volt service drawing 60 Amps at 1.00 PF

How much power is being drawn?

Power = 120 x 60 x 1.00 = 7,200 Watts

How many VA are being drawn?

VA = 120 x 60 = 7,200 Volt Amperes



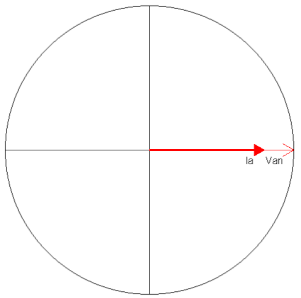
Basic AC Theory
Power – The Simple View

E = Voltage (rms)
I = Current (rms)
PF = Power Factor
Power = Watts = E x I x PF
Power is sometimes referred to as Demand

Sinusoidal Waveforms Only

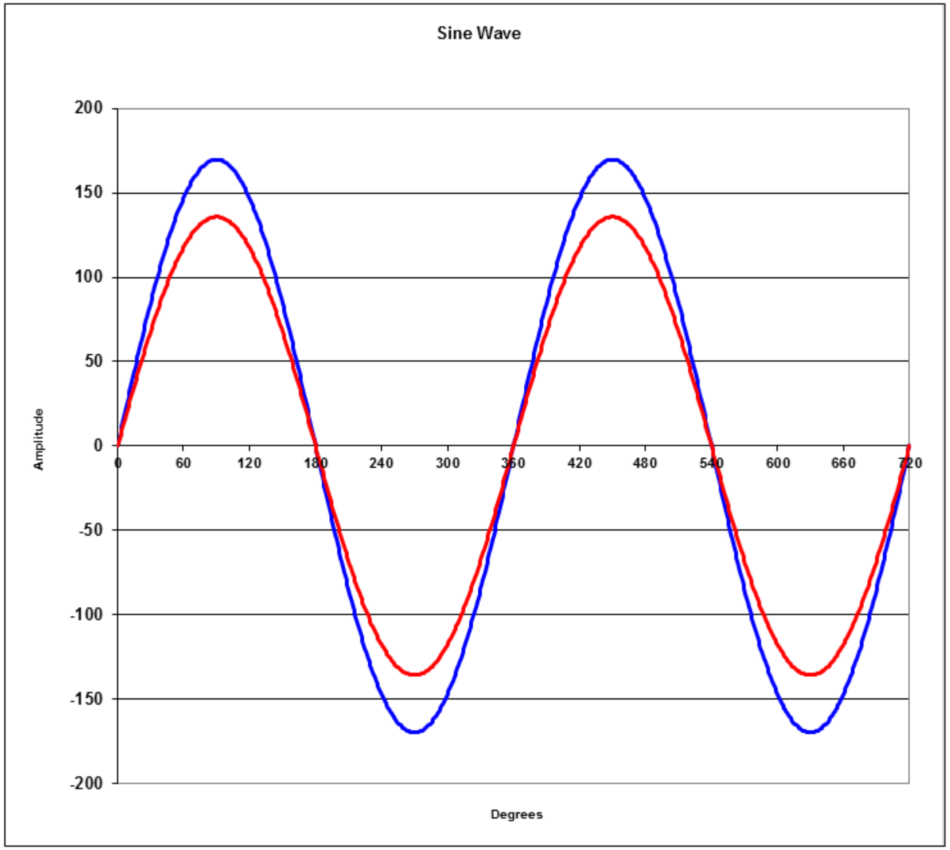
NO Harmonics

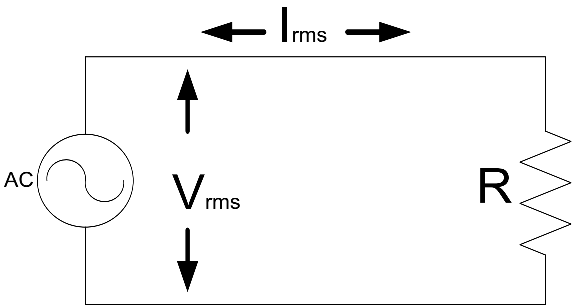
For a 120 Volt service drawing 13 Amps at Unity (1.0) PF, how much power is being drawn?

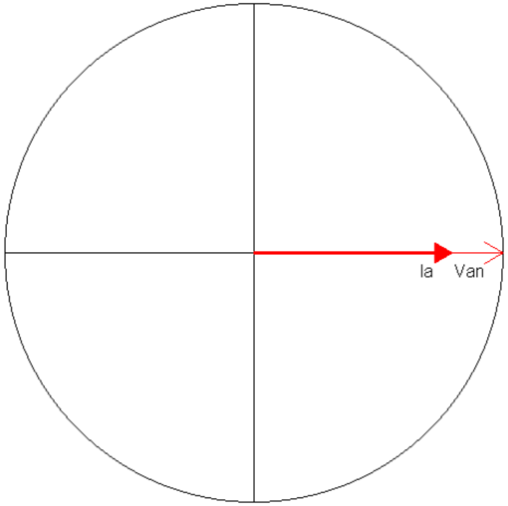


Power = 120 x 13 x 1.0 = 1560 Watts

Basic AC Theory
Power Factor = 1.0

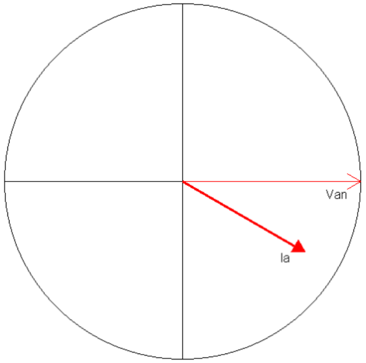






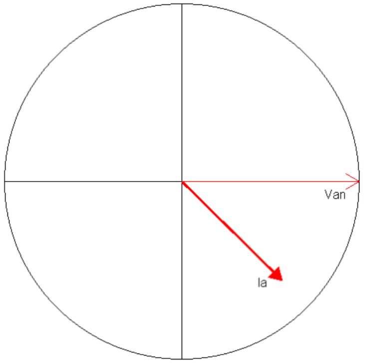
Basic Meter Math
Power – The Simple View

For a 120 Volt service drawing
13 Amps at 0.866 PF,
how much power is being drawn?



Power = 120 x 13 x 0.866 = 1351 Watts

For a 480 Volt service drawing
156 Amps at 0.712 PF,
how much power is being drawn?



Power = 480 x 156 x 0.712 = 53,315 Watts

BASIC AC THEORY
POWER – THE SIMPLE VIEW

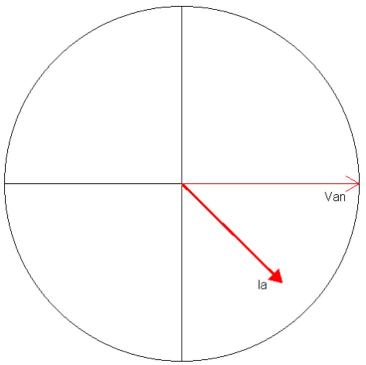
In the previous example we had:

Power = 480 x 156 x 0.712 = 53,315 Watts

Normally we don't talk about Watts, we speak in Kilowatts

1000 Watts = 1 Kilowatt = 1 kW

Watts / 1000 = Kilowatts



For a 480 Volt service drawing
156 Amps at Unity (0.712) PF,
how many Kilowatts are being drawn?

Power = 480 x 156 x 0.712 / 1000 = 53.315 kW

BASIC AC THEORY
ENERGY – WHAT WE SELL

If power is how fast water flows from a pipe, then energy is how much water we have in a bucket after the water has been flowing for a specified time.

Energy = Power x Time

1 kW for 1 Hour = 1 Kilowatt-Hour = 1 kWh

Energy (Wh) = E x I x PF x T

where T = time in hours

Energy (kW) = (E x I x PF / 1000) x T

Energy – What We Sell

For a 120 Volt service drawing 45 Amps at a Power Factor of 0.9 for 1 day, how much Energy (kWh) has been used?

Energy = (120 x 45 x 0.9 / 1000) x 24 = 116.64 kWh

For a 240 Volt service drawing 60 Amps at a Power Factor of 1.0 for 5.5 hours, how much Energy (kWh) has been used?

Energy = (240 x 60 x 1.0 / 1000) x 5.5 = 79.2 kWh

Basic Meter Math
Energy – What We Sell

For a 120 Volt service drawing 20 Amps at a Power Factor of 0.8 from 8:00AM to 6:00PM, and 1 Amp at PF=1.0 from 6:00PM to 8:00AM how much Energy (kWh) has been used?

8:00AM to 6:00PM = 10 hours
6:00PM to 8:00AM = 14 hours

Energy = (120 x 20 x 0.8 / 1000) x 10 = 19.2 kWh

Energy = (120 x 1 x 1 / 1000) x 14 = 1.68 kWh

Energy = 19.2 kWh + 1.68 kWh = 20.88 kWh

BASIC ENERGY FORMULA

- The essential specification of a watthour meter's measurement is given by the value
  K_h [Watthours per disk revolution]

- The watthour meter formula is as follows:

$$E\left[\textbf{Watthours}\right] = K_h\left[\frac{\textbf{watthours}}{\textbf{disk revolution}}\right] * n\left[\textbf{disk revolutions}\right]$$

Meter Shop Accuracy Test Demo

Meter Accuracy Testing

tescometering.com

Meter Accuracy Testing in a Nutshell

✓ Full Load
✓ Light Load
✓ Power Factor

QUESTIONS AND DISCUSSION

Perry Lawton
Northeast Regional Sales Manager
perry.lawton@tescometering.com

Michael Mayer
Owner, CB Associates
michaelM@cb-associates.com

TESCO – The Eastern Specialty Company

Bristol, PA

215.228.0500

This presentation can also be found under Meter Conferences and Schools on the TESCO website: tescometering.com

ISO 9001:2015 Certified Quality Company
ISO 17025:2017 Accredited Laboratory