TESCO METERING

TSTM INCORPORATED

TESCO's Meter School
TESCOOL
July 20-23, 2025

July 22, 2025
10:30 AM – 12:00 PM
Mike Sprang TSTM

INTRODUCTION

TSTM INCORPORATED

TSTM Inc. is an industry leading manufacturer of secondary voltage transformers. Across the United States, Investor-Owned Utilities, Electric Cooperatives, and Municipal Utilities, trust TSTM products for use in electric metering applications. Our unique line of products create a safe work environment, ensure revenue grade accuracy, and provide necessary component protection for utility, industrial, and commercial installations. Our products are manufactured and assembled in the USA.

MUST BE EFFECTIVE AND ACCURATE

- Utility Operations depend on Revenue
- Meters are the Cash Register of the System
- Everyone is Responsible for Generating Income ***"OWN IT!"***

System Accuracy

- Defined by American National Standards Institute (ANSI)
- “Revenue Grade Accuracy”
  - Accuracy Classes based on Product Operation
  - Must be Verified, Recorded, and Periodically Reviewed
- Critical for Efficient Operation

Power not Measured is Power not paid

An Estimated $6 Billion is lost annually due to Billing errors.

- Incorrect Billing Multipliers are the most common Mistake in Billing

ANSI

American National Standards Institute

SELF CONTAINED METERING

- Amperage is measured directly by the meter
- Residential single phase
- Small commercial single and three phase

TRANSFORMER RATED METERING
(A SCALED DOWN REPRESENTATION OF THE LOAD)

- Current Transformers are used to Reduce a large load, usually 600Amps or greater, to a value less than 20 Amps. (Class 20 Meter)
- If used, Voltage Transformers Must be Included in conjunction with Current Transformers in the Meter Billing Multiplier or Transformer Factor to apply the correct value
- Since we are reducing the Voltage and Current of a Large Load to a Useable Metering Amperage, (20 amps or less),we need to expand that value after it is metered to properly apply it to the amount billed to the customer.
  - **If the Multipliers are wrong, you will either Overbill or Underbill the customer**
  - **Incorrect Multipliers are the most common error in Metering**

CALCULATING THE TRANSFORMER FACTOR (TF)

- The “Transformer Factor” or “TF” is the product of the CT and VT Ratios used to Multiply the meter readings (kWh, kW, kVAR, kVA) to obtain the energy usage to be billed to the consumer.

- Example: You serve a Commercial service with a 112 ½ kVA, 480/277VAC, Four Wire Wye Pad mount transformer.
- The engineer specified using 200:5 Current Transformers and Voltage Transformers with a 2.5:1 Ratio

Transformer Factor = CT Ratio-200 ÷ 5=40 X VT Ratio of 2.5

40 x 2.5 = 100

Transformer Factor or Meter Multiplier is 100

WHAT IF ?

- VT Ratio is incorrectly listed as 2.4:1 (Mult. of 96) in Billing Software
- Meter Reads 1000 KWH
- Total Usage is 1000 X TF@ = 96,000KWH
- Rate at $0.12 X 96,000 KWH Charge = $11.520.00

- Same Meter Reading of 1000 KWH
- Correct VT Ratio of 2.5:1 (Mult. of 100) applied to the same 1000 KWH
- 1000 KWH X TF@ 100 = 1000,000KWH
- Rate at $0.12 X 100,000 KWH charge = $12,000.00

- A loss of $480.00 per 100,000 KWH

SAFTEY


DANGER
DO NOT TOUCH
NOT ONLY WILL THIS KILL
YOU, IT WILL HURT THE WHOLE
TIME YOU ARE DYING

METERING SAFETY

- ARE YOU DOING ALL YOU CAN TO WORK SAFELY?
  - DO YOU CONSIDER 480 VOLTS A SAFE WORKING VOLTAGE FOR METERING?
  - HAVE YOU EXPERIENCED A 480V FAULT?
  - DO YOU USE VOLTAGE TRANSFORMERS?
    - Are Voltage Transformers or a Maximum Metering Voltage included in your Standards?
    - *"All 277/480 or 480 volt services will require metering instrument voltage transformers to reduce voltage to < 120V for 277/480V services, or <=240V for 480V services."*

Voltage transformers create a Safe Working Voltage

480 Volts is NOT a safe metering voltage

- Protection of System Components
- Reduce Stress on the Meter
- Require less PPE and Manpower
- **System Cost is less than 1 Hour in a Hospital Burn Unit**

VOLTAGE TRANSFORMERS

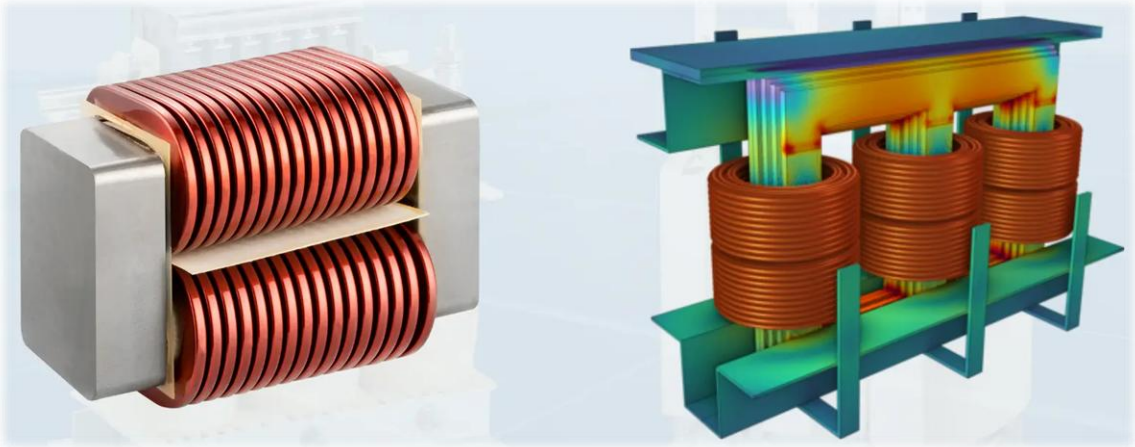
- What are they
  - VT'S, Voltage Transformers
  - PT's, Potential Transformers
    - Different names depending on Training Etc.
  - Reduce Voltage to the Meter Socket for Transformer Rated Metering
  - Typical Application 3 Phase Services above 600amps

VOLTAGE TRANSFORMERS

- Common Ratios
  - 4:1, 2:1, 2.4:1, 2.5:1
  - Secondary Voltage is the Result of Primary Voltage Divided by the Ratio
  - Voltage is proportional to input, not a set value
    - 480V Primary @ 4:1 = ~120V Secondary
    - 480V Primary @ 2:1 = ~240V Secondary
    - 277V Primary @ 2.4:1 = ~116V Secondary
    - 277V Primary @ 2.5:1 = ~111V Secondary

Types of Voltage Transformers

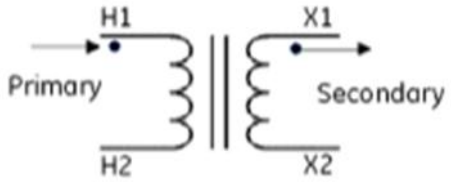
Core and Coil – Traditional Design



Toroid – Revolutionary Design

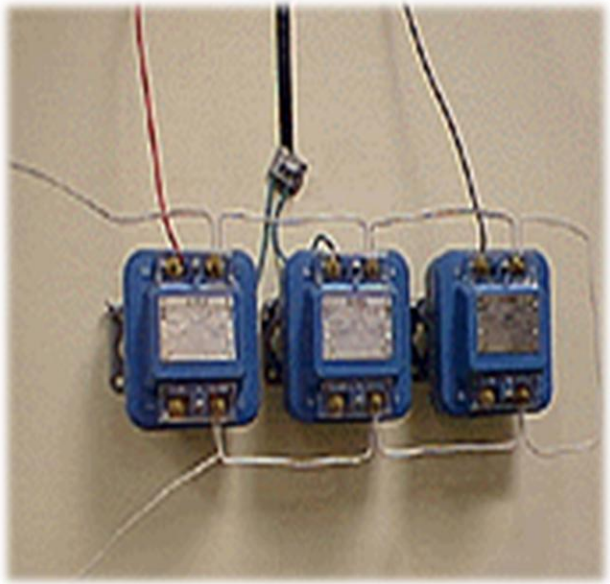
TRADITIONAL METERING TECHNOLOGY

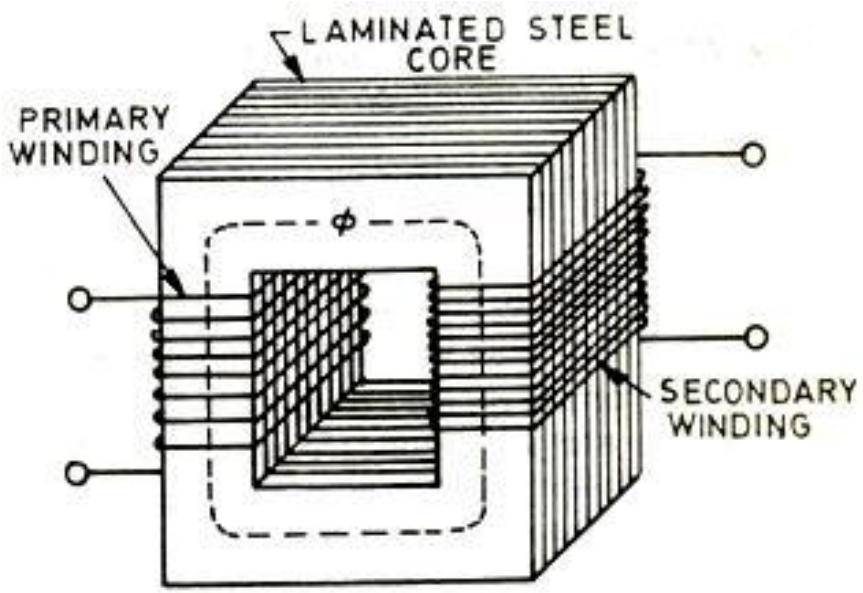
- Traditional Voltage Transformers
    - Primary and secondary core and coil winding 2 or 3 needed per installation



- Traditional transformers are heavy 9-10 lbs Each
- Require multiple mounting holes
- Multiple wire connections necessary for system function create possibilities for miswiring and product failure
- System Signals (AMI) are not easily passed through due to electrical separation

CONVENTIONAL PT/VT





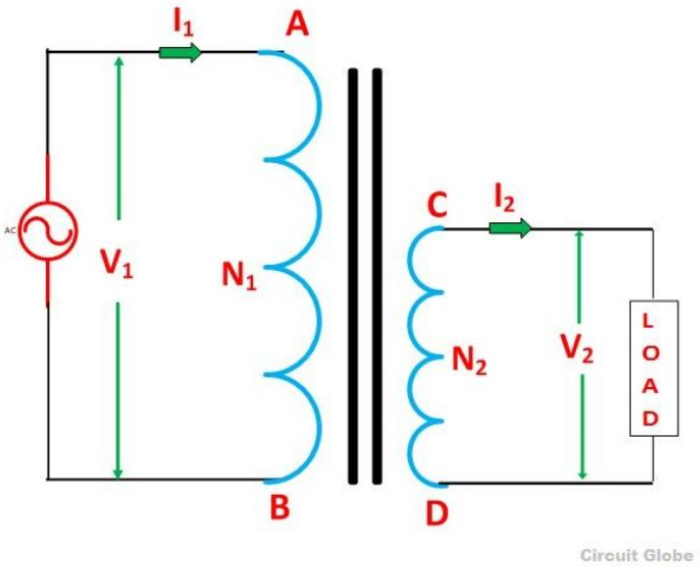
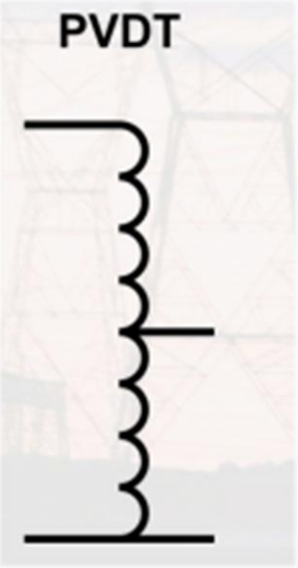
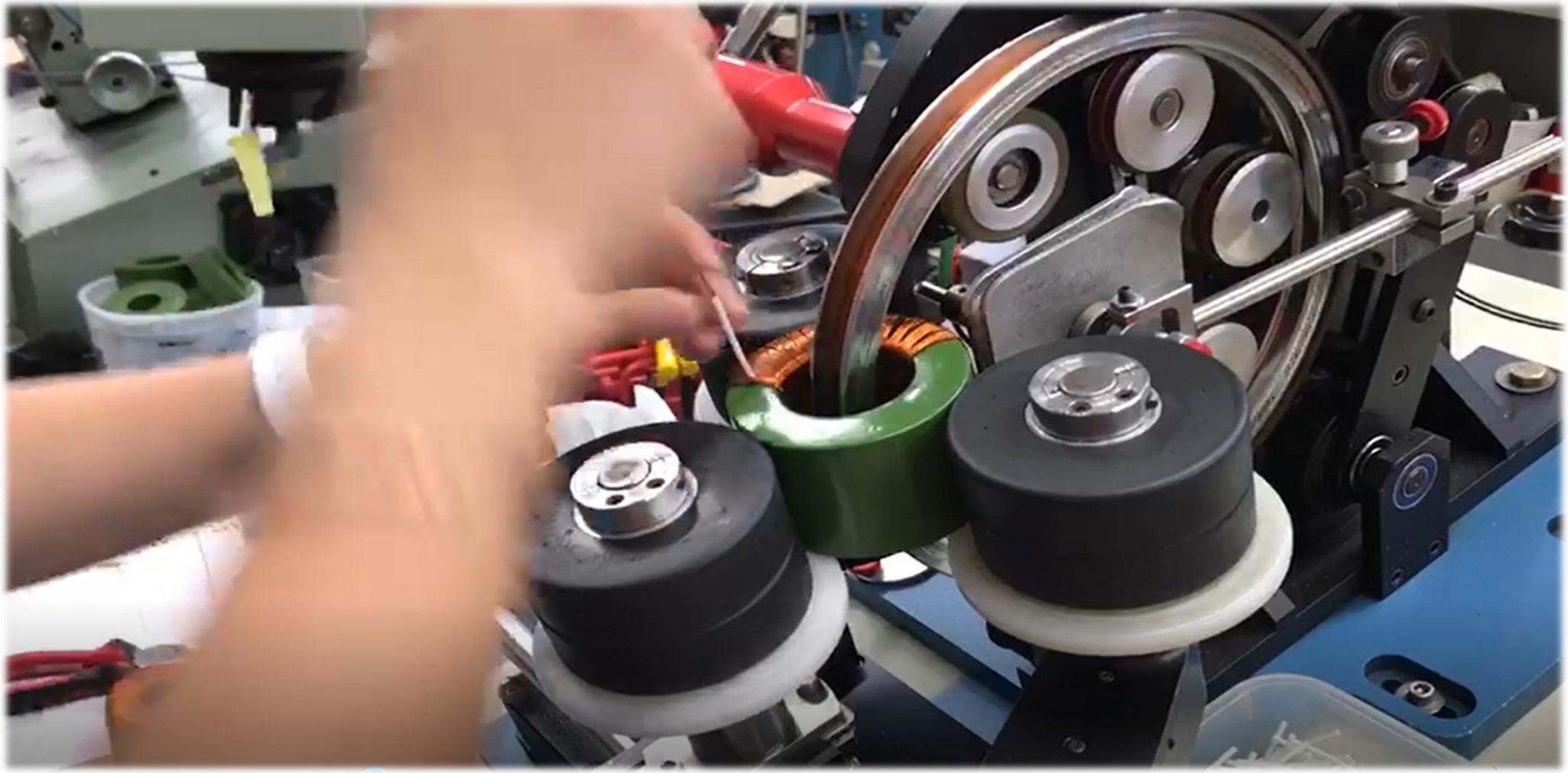


Figure A: Ordinary Two Winding Transformer

TOROIDAL VOLTAGE TRANSFORMERS

- Extremely stable Autotransformer design
- Single winding around a Toroidal core
- Output ratio – mathematical calculation based upon turns
- Self protecting, also provides protection for other system components
- High Accuracy Stable Device
- Suppresses high frequency noise and reverse EMF from Large Motors
- Autotransformer design allows system signals to transmit easily





TSTM VOLTAGE TRANSFORMERS

- **TSTM VT-PACK™**
- Low Profile Design
- Weighs only 14 Pounds
- Mounts in Pad-Mount Transformers, CT Cabinets, Switchgear, Meter Sockets, or TSTM enclosures.
- Can be easily integrated into TESCO Trans-Sockets or Custom Meter Sockets at customer request
- Can be Pole-top mounted, connector cover required
- Up to 3 Transformers in 1 Weatherproof UV Stabilized Enclosure
- Wires with Wiring Harness
  - Custom Harnesses available in specified color, striping, and conductor length, based on customer requirements

TSTM VOLTAGE TRANSFORMERS

- **TSTM VERSA-Pack™**
- Same Revenue Grade Transformers as the VT-Pack
- Individual Modules Mounted on a Backplane
- Common Buss Assembly for “HO” “XO” Neutral / Common Connections
- “H1” and “X1” Primary and Secondary Terminals on each Module
- Hold down strap to hold transformer modules securely in place.

TSTM Auxiliary Transformers

- Compact Autotransformer Design
- Not Revenue Grade
- Various Input and Output Voltages
- Powers peripheral System Devices

CATALOG NUMBER	VOLTAGE	VA RATING	MOUNTING
4824-AUX	480:240	135	INTERNAL OR EXTERNAL
4824-AUX-300	480:240	300	INTERNAL OR EXTERNAL
4812-AUX	480:120	200	INTERNAL OR EXTERNAL
277/240/120-AUX	277/240:120	135	INTERNAL OR EXTERNAL
480/360/240/120-AUX	480/360/240:120	100	INTERNAL OR EXTERNAL

LIGHTNING EFFECTS ON METERING

- Solid State meters, power supplies and AMI modules
  - Susceptible to voltage surges, lightning, fast transients and switching
  - Most common where meter voltages are greater than 240 volts
    - Voltage Transformers help protect components
  - Review grounding policies and procedures to help protect meters
    - Limit grounding points when using voltage transformers.
    - A fault will take all paths to ground.

ASTRAPHOBIA

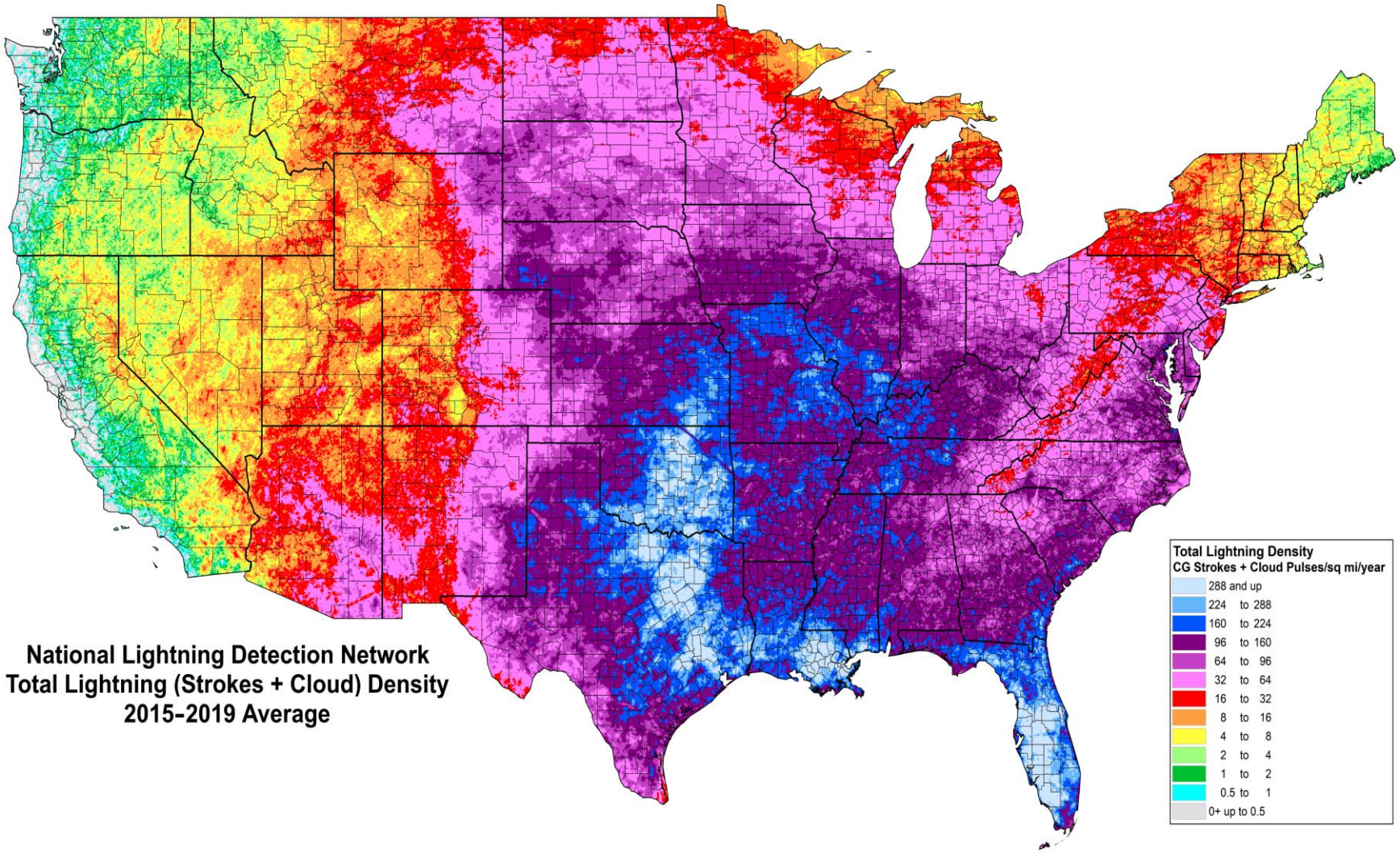
- Astraphobia, also know as Brontophobia, is an abnormal fear of Thunder and Lightning or an unwarranted fear of Scattered and/or Isolated Thunderstorms.
- It is a specific type of Phobia that both Humans and Animals can develop.

LIGHTNING FACTS

- An enormous “discharge” of immense energy (Typically ~ 0.2 msec)
- A lightning bolt is anywhere from 1,000,000 to 1,000,000,000 volts and between 10,000 and 20,000 amps
- Lightning can reach air temperatures around 50,000º F
- **5X** Hotter than the surface of the Sun!
- Lightning strikes the U.S. about 20-40 million times a year

FACTS ABOUT LIGHTNING…

- Lowest amount of Lightning Deaths in the US
  - 2021 and YTD 2024 Only 11 each year
- Most Lightning Deaths in the US 1943 – 432
- In 2001 the US Averaged 47 Deaths per Year
- Average Deaths in US 2017 – 2023
  17 Per Year 82% were male
- There were 6 Lightning related deaths in New York State 2010 - 2019


National Lightning Detection Network
Total Lightning (Strokes + Cloud) Density
2015-2019 Average
Total Lightning Density
CG Strokes + Cloud Pulses/sq mi/year
288 and up
224 to 288
160 to 224
96 to 160
64 to 96
32 to 64
16 to 32
8 to 16
4 to 8
2 to 4
1 to 2
0.5 to 1
0+ up to 0.5

FACTS ABOUT LIGHTNING…

- Who gets the most ??
  - Texas
  - Florida
  - Oklahoma
  - Louisiana
- Why doesn't the West Coast or Maine get as much ???
  - Cool water off the Coast creates a cool air flow inland
    - Stabilizes the atmosphere
    - Lacks warm moist air and Instability needed to create Thunderstorm

FACTS ABOUT LIGHTNING…

- Lightning Helps Plants Grow
- Lightning serves an important role in the nitrogen cycle by oxidizing diatomic nitrogen in the air into nitrates which are deposited by rain and can fertilize the growth of plants and other organisms
- As lightning travels through sandy soil, the soil surrounding the plasma channel may melt, forming tubular structures called ***Fulgurites***.
- ”Fossilized Lightning”
- A bolt of Lightning is only 2” – 7” Wide
- Even though they appear much larger

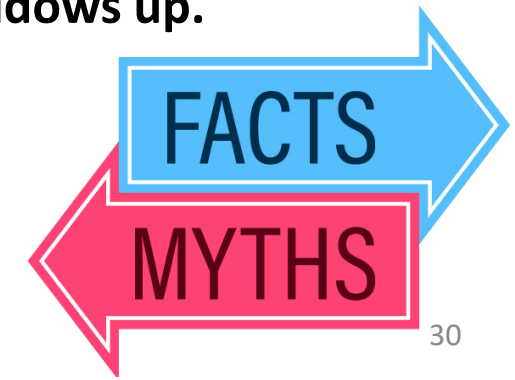
FACTS ABOUT LIGHTNING…

Why do Trees Explode ?

Extreme Heat Generated by Lightning vaporizes moisture

LIGHTNING MYTHS & FACTS

- Myth: If Outside in a thunderstorm you should shelter under a tree
- **Fact: Being Underneath a tree is the second leading cause of lightning casualties. Better to be wet than fried!**
- Myth: A lightning victim is electrified, if you touch then you will be electrocuted
- **Fact: The Human body does not store energy. It is safe to touch them.**
  - **Begin CPR or Medical Treatment As soon as possible.**
- Myth: If trapped outside lay flat on the ground
- **Fact: Ground Current from a Lightning strike can travel 60’ or more. Keep moving toward a safe shelter, do not lay down.**
  - **If a building is not available go to a Metal Topped Vehicle and keep the widows up.**



QUESTIONS

What didn’t make sense….

Course Feedback

Please Take a Few Minutes To Provide Feeback About The Course & Instructor

TESCO METERING

THANK YOU

John Pollard – Director of Technical Operations

Office 605-334-2924

Cell 605-359-4543

johnpollard@ts-tm.com

Mike Sprang – Director of Sales

Office 605-334-2924

Cell 605-351-1446

mikesprang@ts-tm.com

TSTM Office and Testing Laboratory located in Sioux Falls SD

2900 Sencore Drive Suite 100 Sioux Falls, SD 57107

www.ts-tm.com