THE EASTERN SPECIALTY COMPANY

COMPLETE SITE TESTING

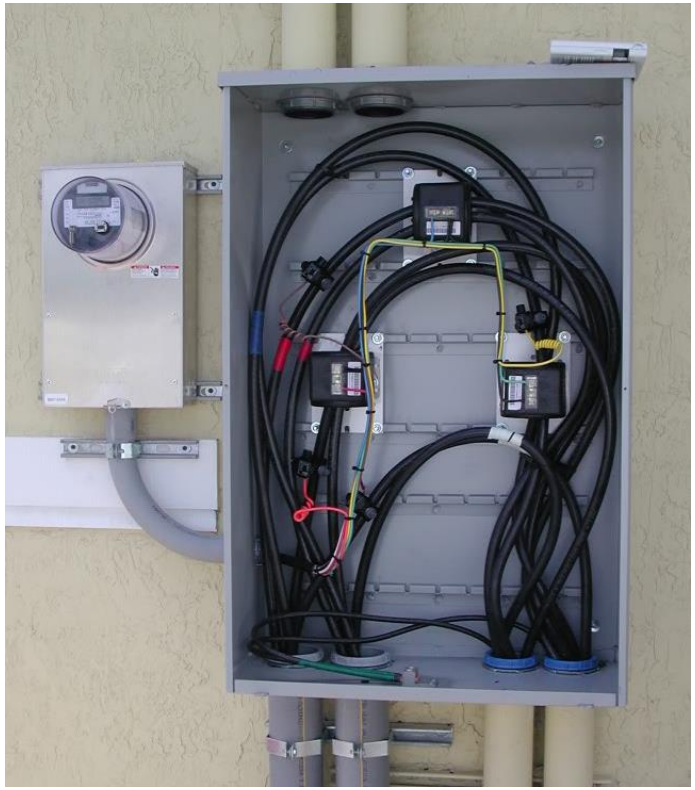
Prepared by Tom Lawton, TESCO
The Eastern Specialty Company

For North Carolina Electric Meter School
Advanced
XXXXXXXXXXXXXX

THE EASTERN SPECIALTY COMPANY

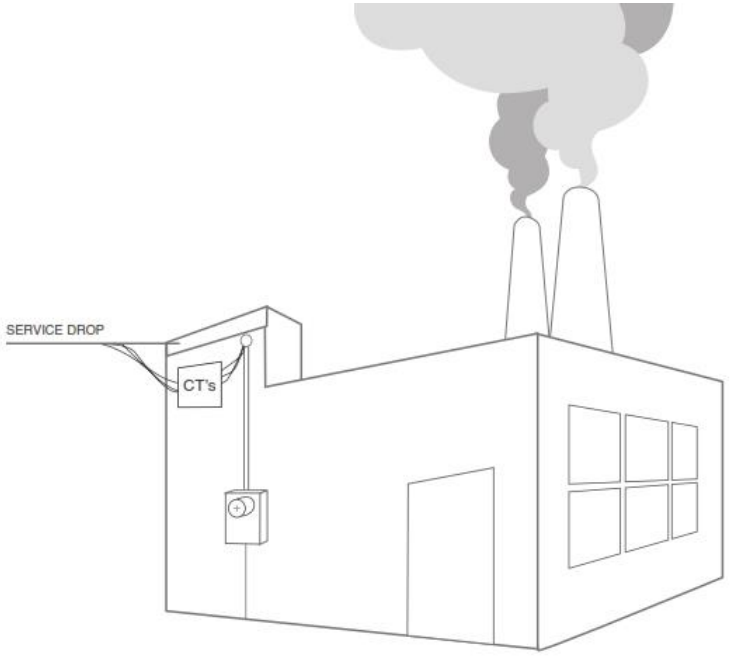
TOPICS WE WILL BE COVERING

- Transformer Rated Meter Forms
- Test Switches and CT's
- Site Inspection and Safety Checks
- Meter Accuracy Testing in the Field
- Checking the Health of your CT's and PT's
- Site Verification and not just meter testing
- Admittance Testing
- Harmonics determination and effects



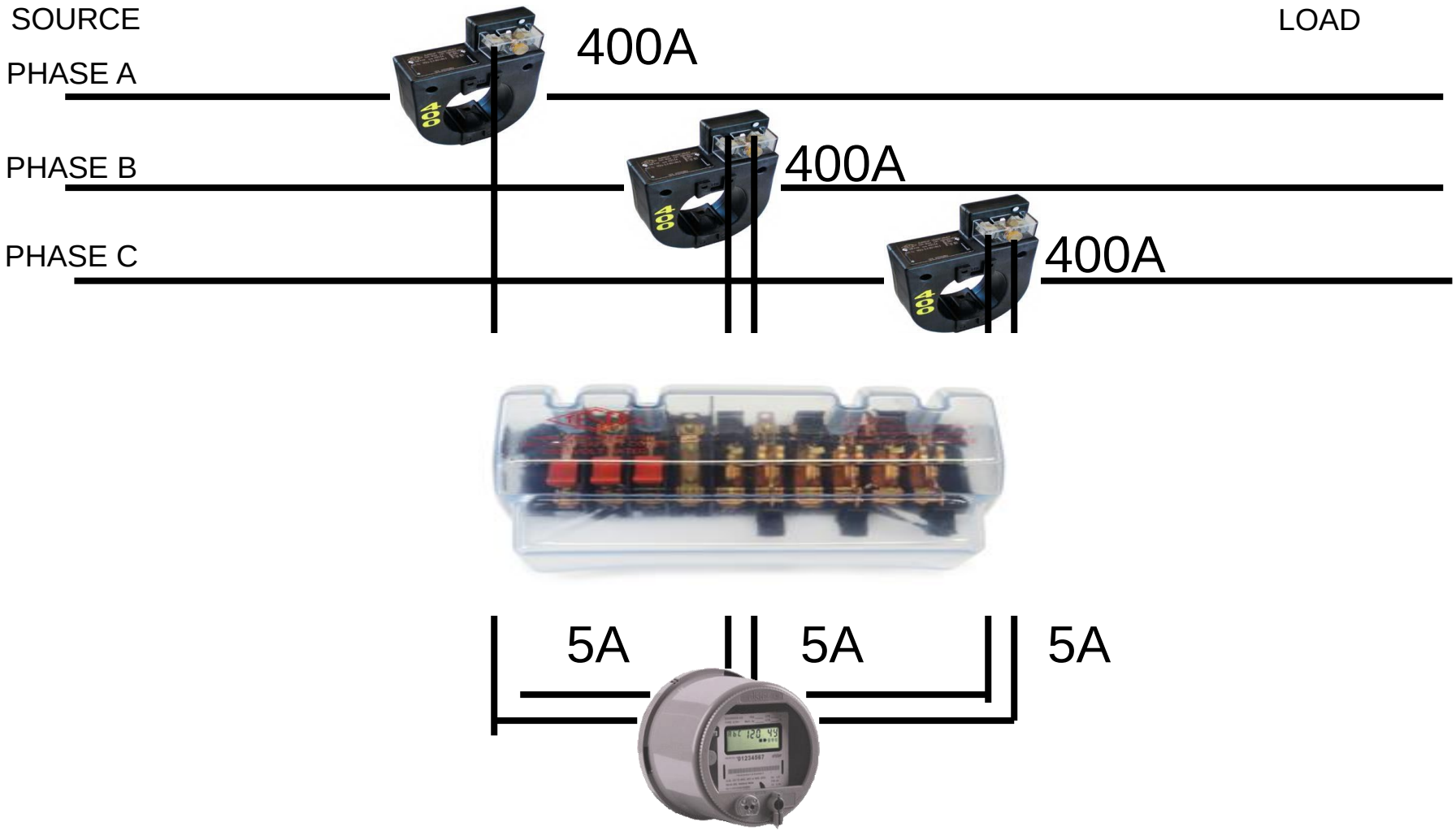
TRANSFORMER RATED METERING

- Meter measures scaled down representation of the load.
- Scaling is accomplished by the use of external current transformers (CTs) and sometimes voltage transformers or PTs).
- The meter is NOT part of the circuit
- When the meter is removed from the socket, power to the customer is not effected.



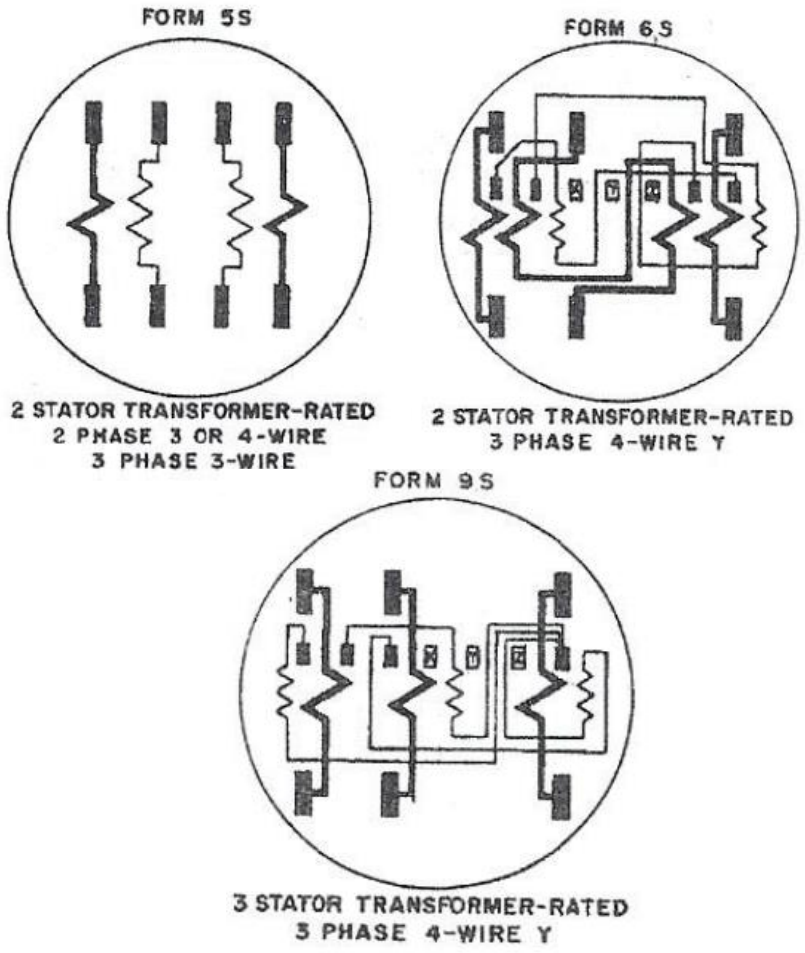
THE BASIC COMPONENTS

9S Meter Installation with 400:5 CT's



THE EASTERN SPECIALTY COMPANY

TYPICAL METER CONNECTIONS



Typical Connections for 3 Phase Common Transformer (Instrument) Rated Meter Forms

Examples :

Form 5s Class 20

Form 6S Class 20

Form 9s Class 20

METER ACCURACY TESTING

Meter Accuracy Testing Customer Load

- ✓ Customer Load
- ✓ Customer Billing
- ✓ Customer Conditions

Meter Accuracy Testing Phantom Load

- ✓ Full Load
- ✓ Light Load
- ✓ Power Factor

The Importance of CT Testing in the Field

- One transformer in three wired backwards will give the customer a bill of 1/3rd the actual bill.
- One broken wire to a single transformer will give the customer a bill of 2/3rd the actual bill
- One dual ratio transformer inappropriately marked in the billing system as 400:5 instead of 800:5 provides a bill that is ½ of the actual bill. And the inverse will give a bill double of what should have been sent. Both are lose-lose situations for the utility.

The Importance of CT Testing in the Field (cont.)

- Cross Phasing (wiring errors)
- Loose or Corroded Connections
- CT Mounted Backwards
- CT's with Shorted Turns
- Wrong Selection of Dual Ratio CT
- Detect Magnetized CT's
- Burden Failure in Secondary Circuit
- Open or Shorted Secondary
- Mislabeled CT's
- Ensures all Shorting Blocks have been Removed

Testing at Transformer Rated Sites

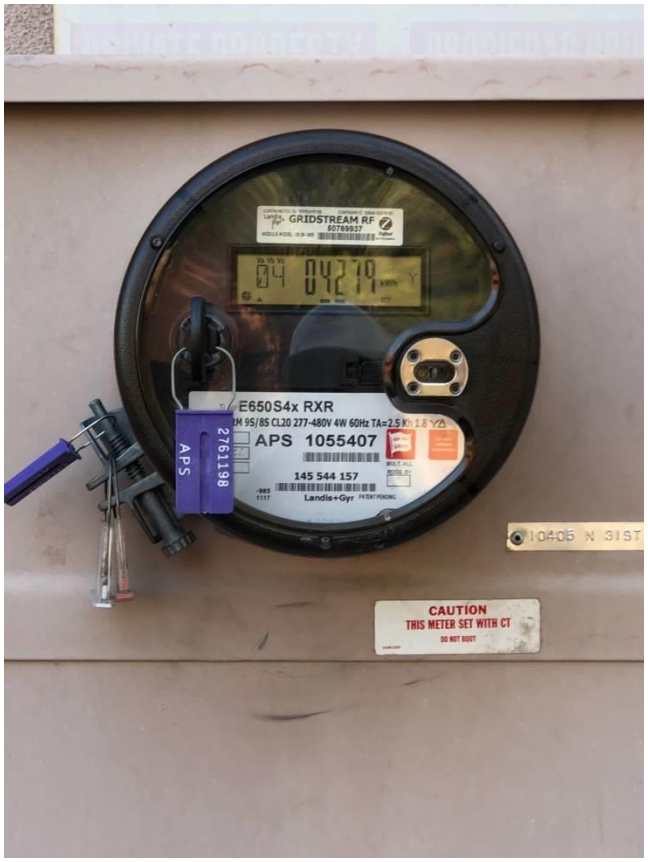
- ✓ Safety walk around site
- ✓ Check PPE
- ✓ Check test switch
- ✓ Tighten any loose connections
- ✓ Check primary cabinet
- ✓ Check connections
- ✓ Thermal scan
- ✓ Connect field tester

Testing at Transformer Rated Sites

- ✓ Meter Accuracy
- ✓ Customer Load
- ✓ Full Load
- ✓ Light Load
- ✓ Power Factor
- ✓ CT Health
- ✓ Burden Testing
- ✓ Ratio Testing
- ✓ Demagnetization
- ✓ Admittance Testing
- ✓Harmonics Assessment
- ✓ Site Verification

THE EASTERN SPECIALTY COMPANY

METER ACCURACY TESTING

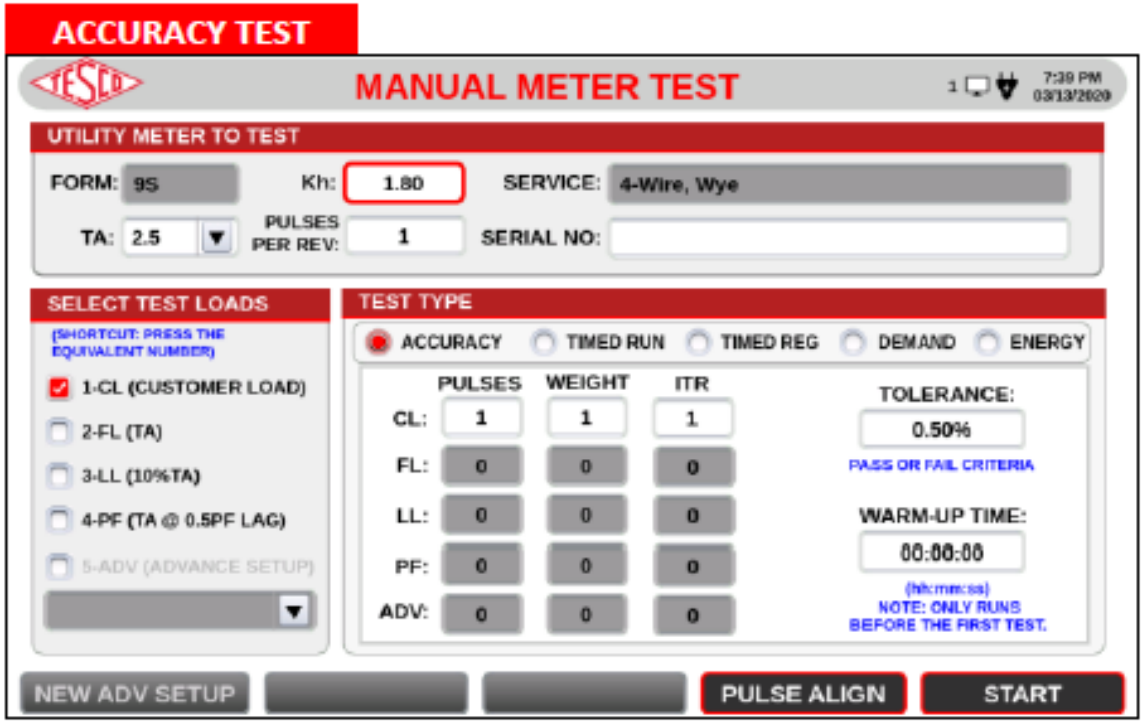


- ✓ Meter Accuracy Test using IR Pulse Detection
- ✓ Make connections from Field Tester to Meter Form
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

METER ACCURACY TESTING

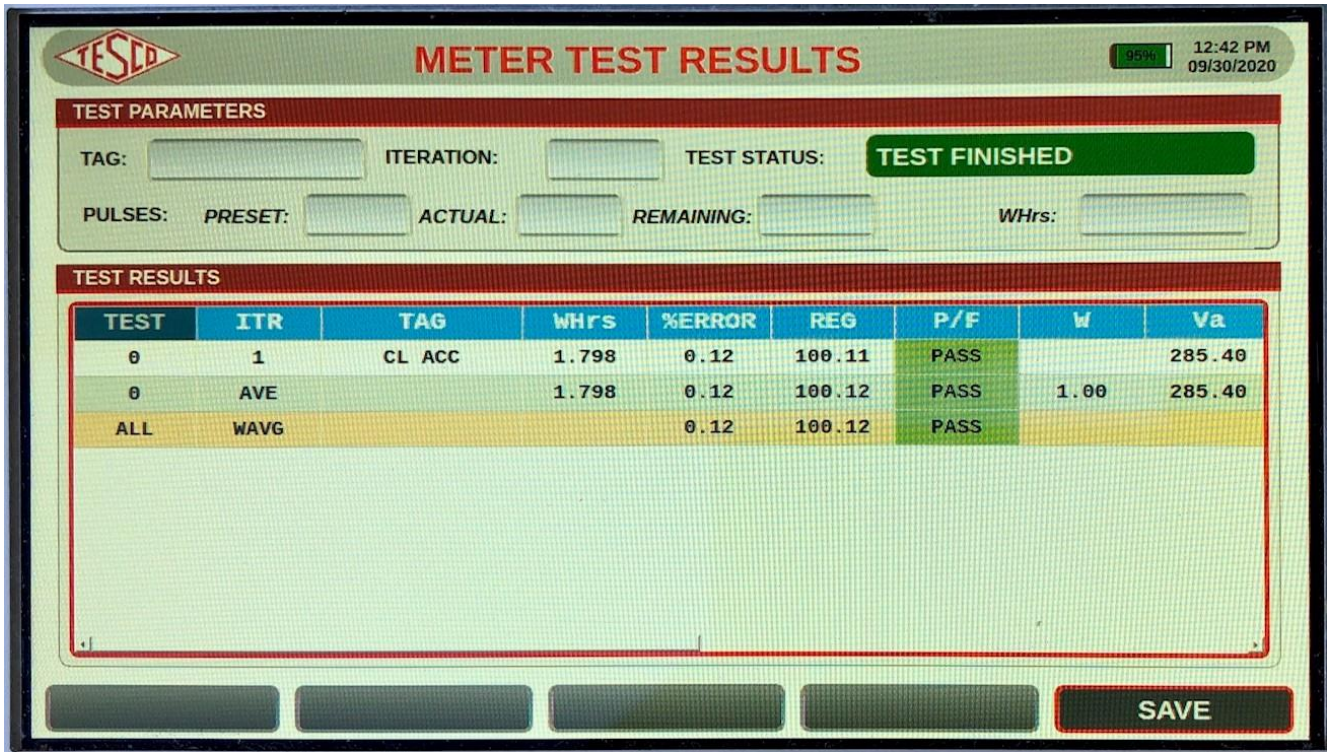
- ✓ Meter Accuracy Test using IR Pulse Detection
- ✓ Make connections from Field Tester to Meter Form
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

METER ACCURACY TESTING



- ✓ Meter Accuracy Test using IR Pulse Detection
- ✓ Make connections from Field Tester to Meter Form
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

METER ACCURACY TESTING



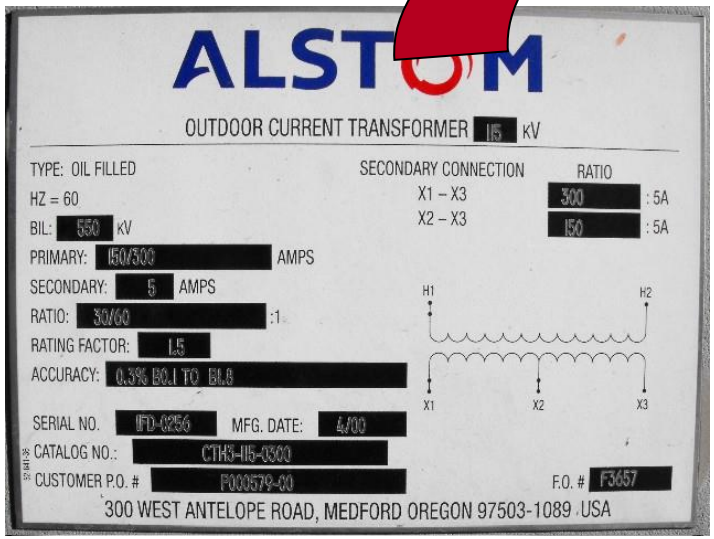
- ✓ Meter Accuracy Test using IR Pulse Detection
- ✓ Make connections from Field Tester to Meter Form
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

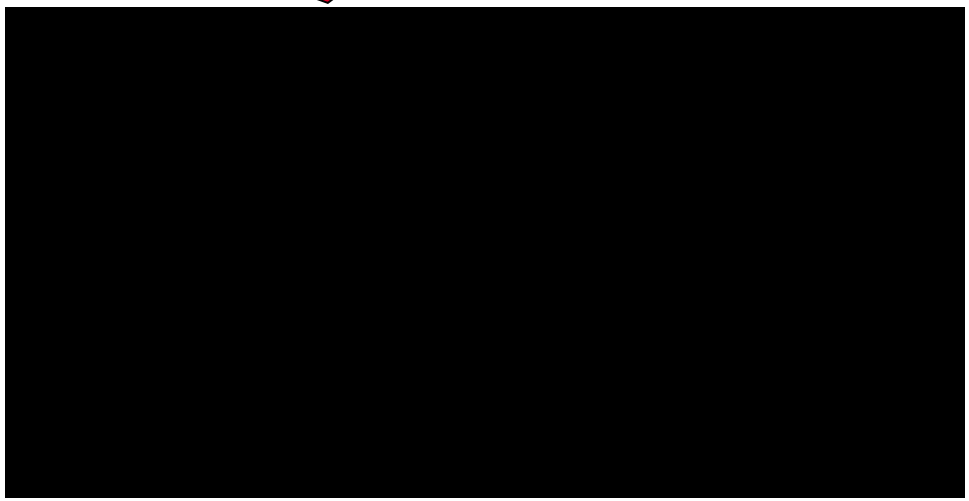
THE EASTERN SPECIALTY COMPANY

CUSTOMER CT RATIO TEST WITH BURDEN

- ✓ Make Connections from Field Tester to Primary current phases
- ✓ Make connections from Field Tester to Secondary test switch
- ✓ Connect IR Pulse Detector to meter output

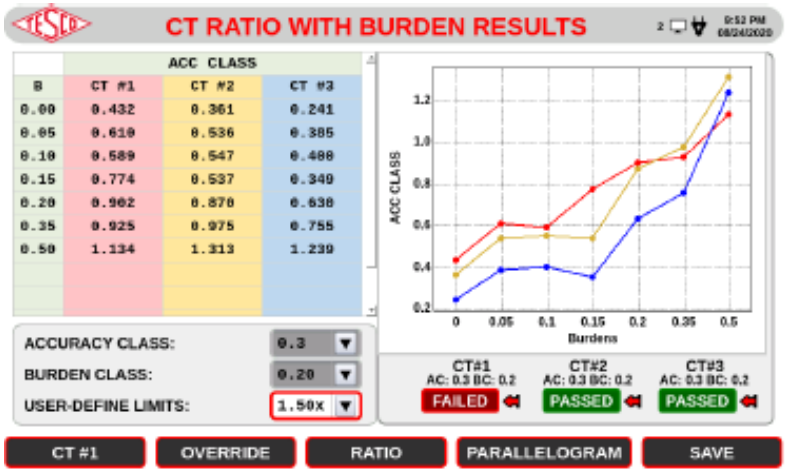
Functionality with Burden Present on the Secondary Loop

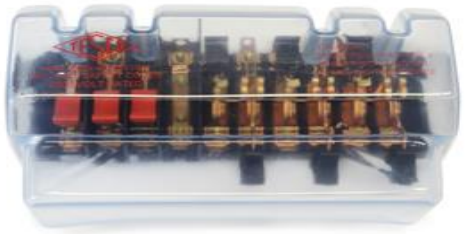




Functionality with Burden Present on the Secondary Loop

PHASE A

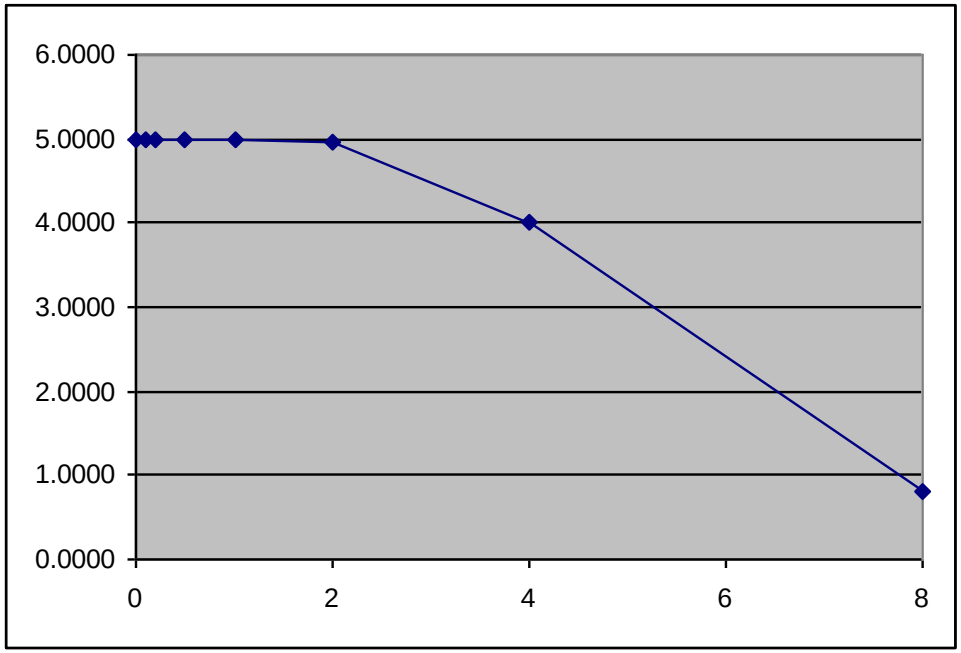




- Some burden will always be present – junctions, meter coils, test switches, cables, etc.
- CT's must be able to maintain an accurate ratio with burden on the secondary.

Functionality with Burden Present on the Secondary Loop

0.3% @ B0.1, B0.2, B0.5

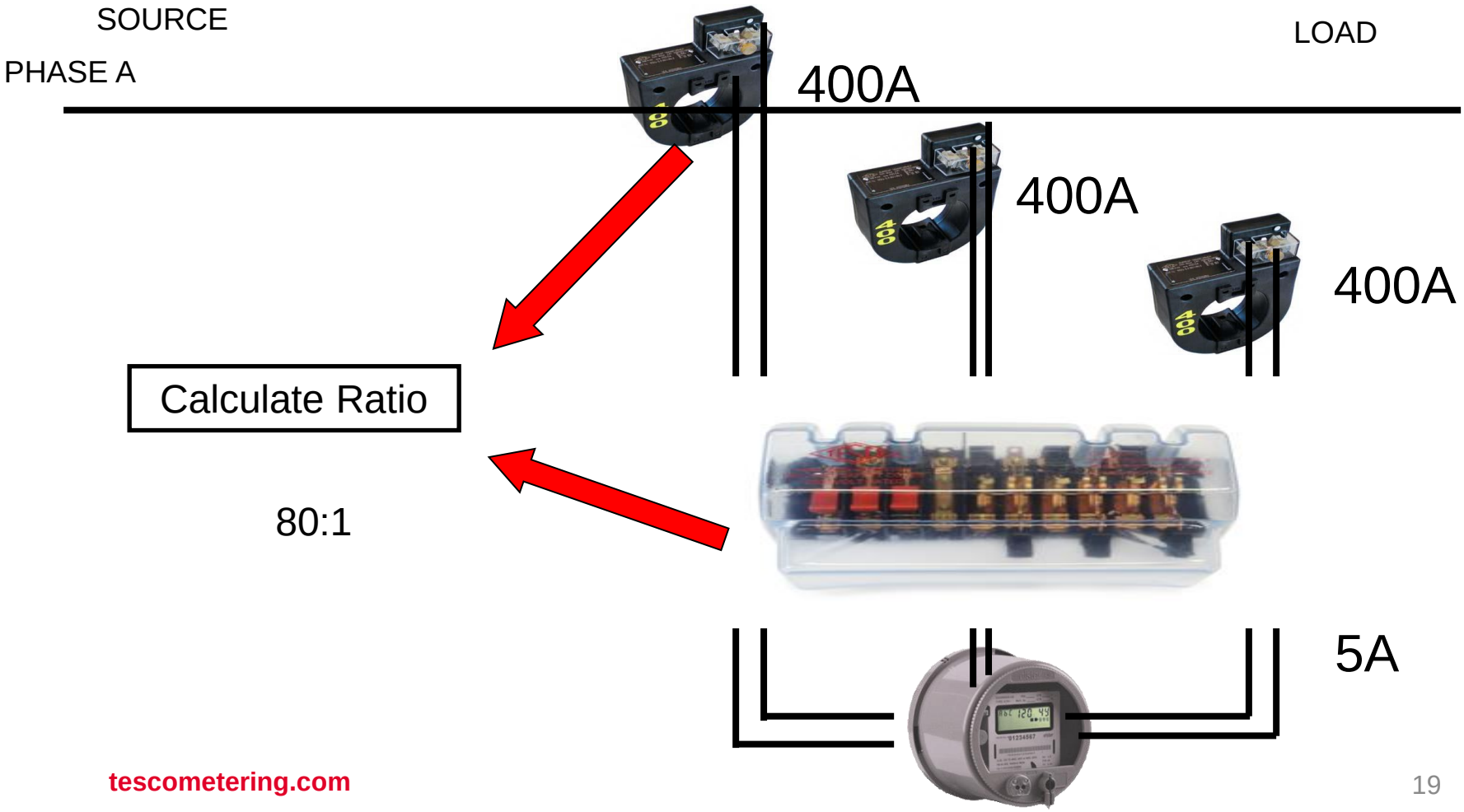


Initial Reading = 5Amps
0.3% x 5A = 0.015A
5A – 0.015 = 4.985A

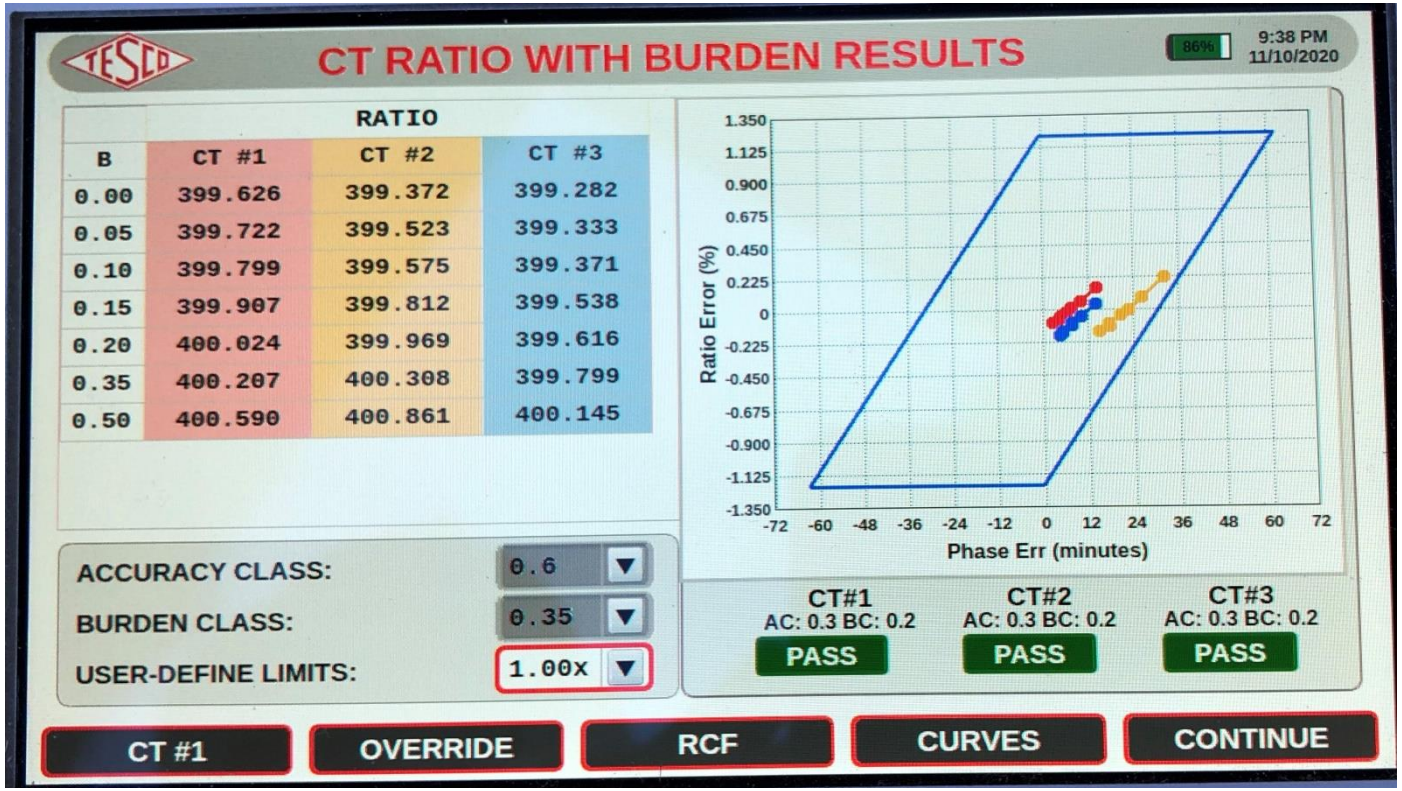
Burden	Reading
0	5.0000
0.1	4.9999
0.2	4.9950
0.5	4.9900
1	4.9800
2	4.9500
4	4.0000
8	0.8000

Fundamentals of Polyphase Field Meter Testing and Site Verification

Ratio of Primary Current to Secondary Current

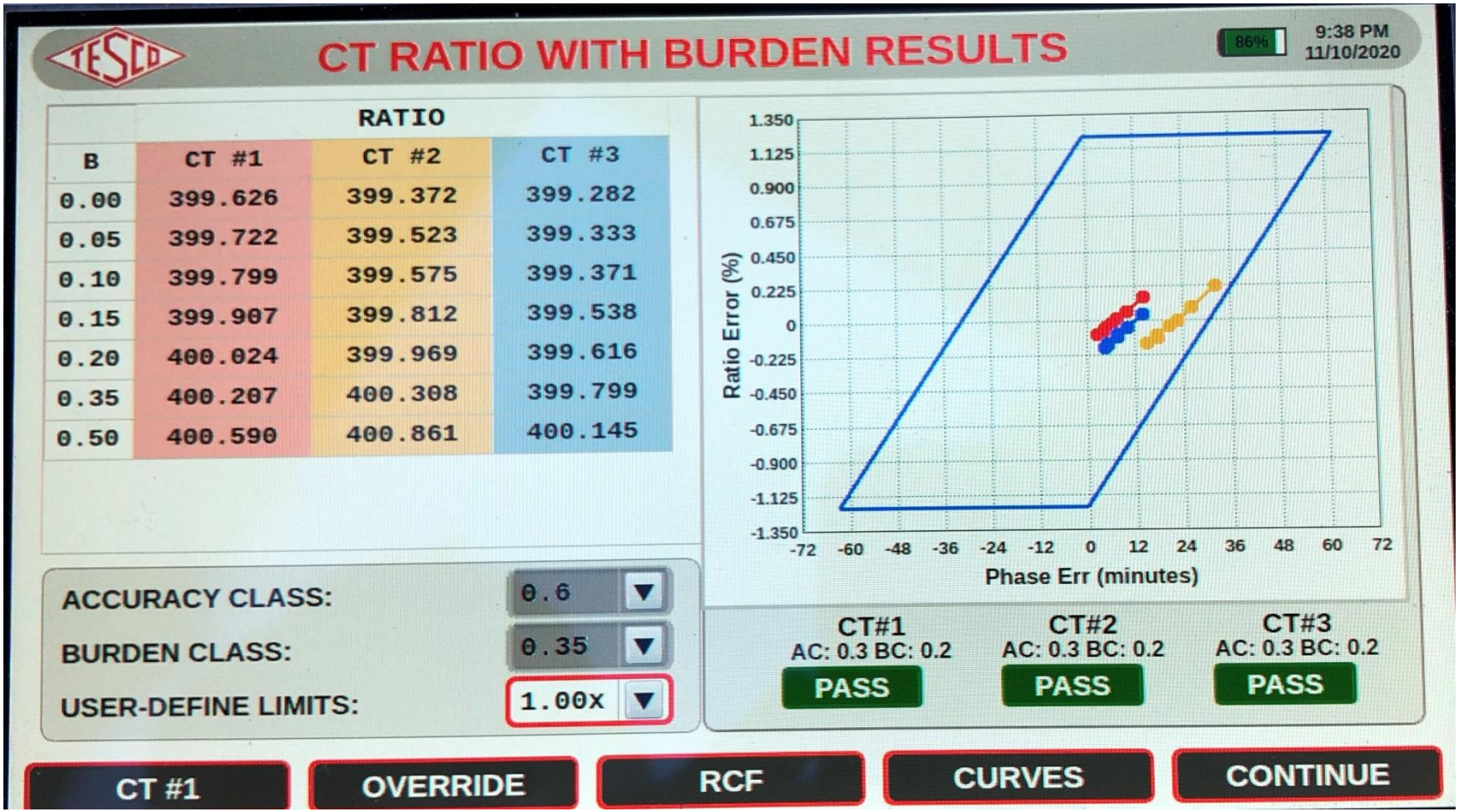


CT Ratio Testing with Burden Added



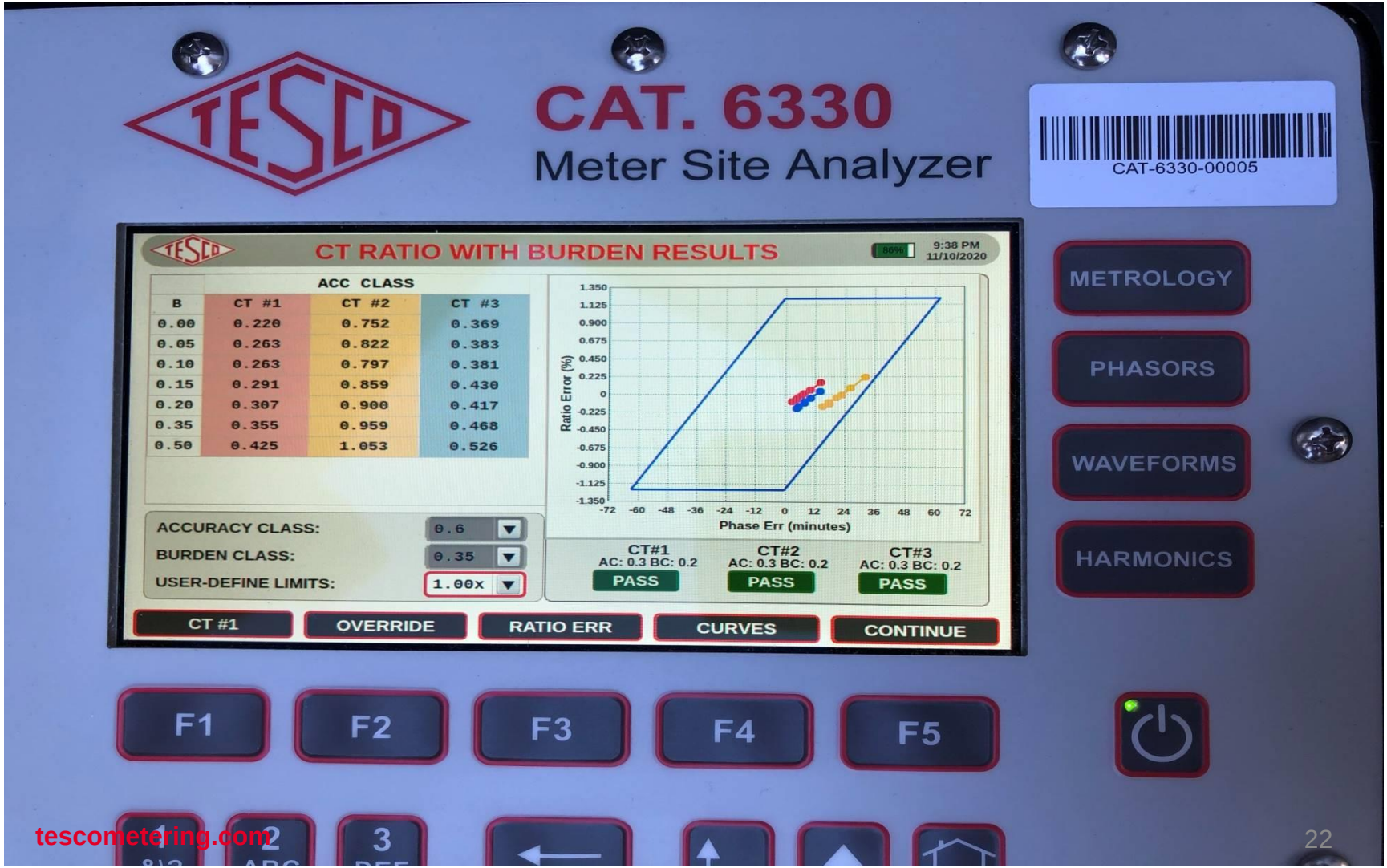
- ✓ Meter Accuracy Test using IR Pulse Detection
- ✓ Make connections from Field Tester to Meter Form
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

CT Ratio Testing with Burden Added



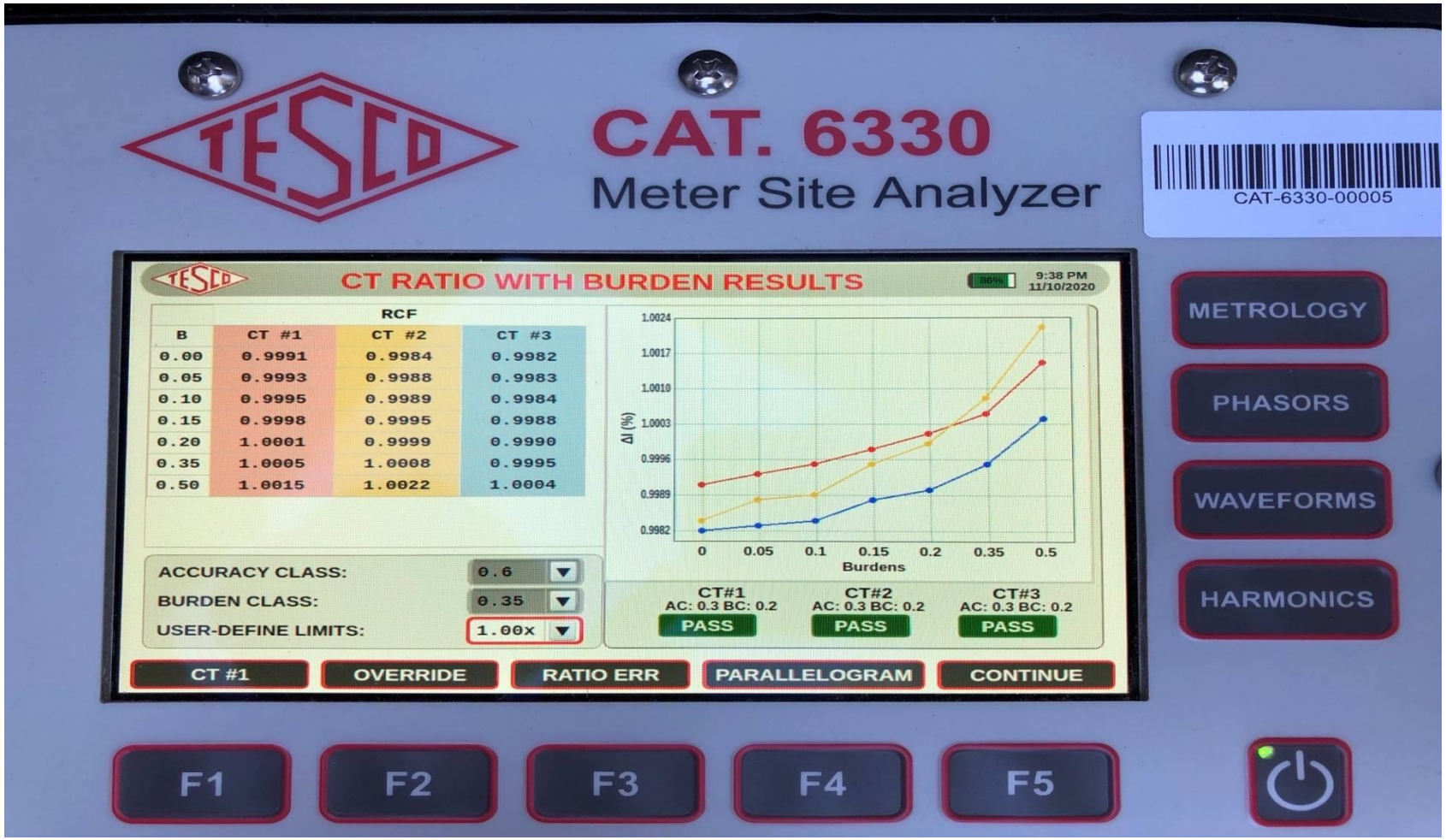
THE EASTERN SPECIALTY COMPANY

CT RATIO TESTING WITH BURDEN ADDED

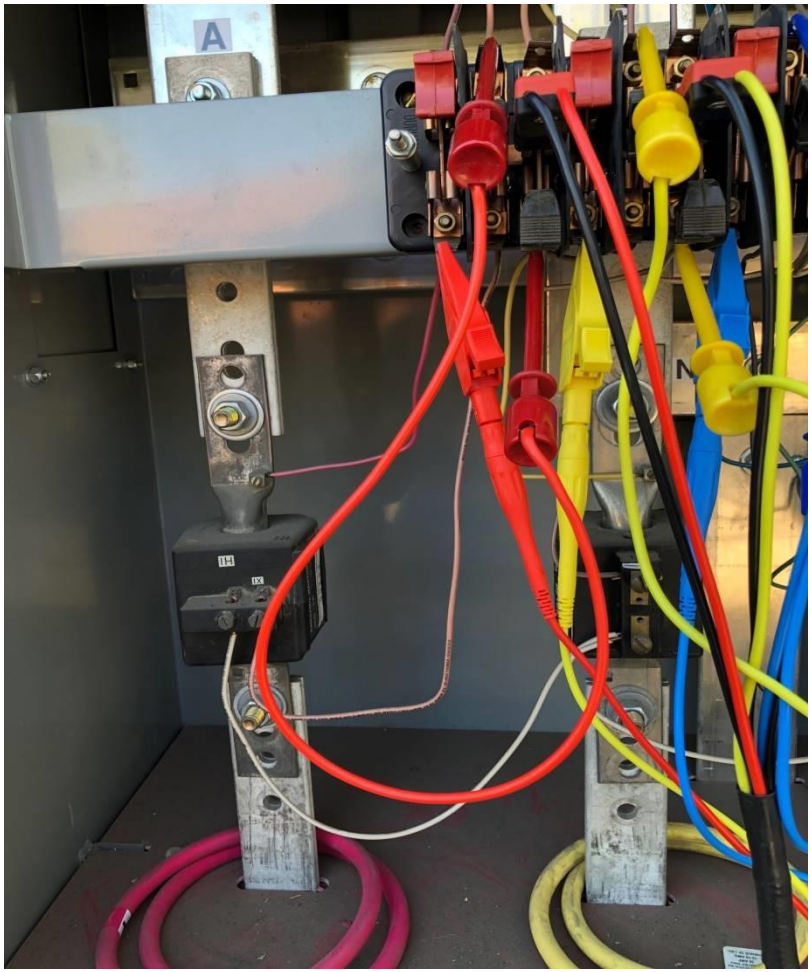


THE EASTERN SPECIALTY COMPANY

CT Ratio Testing with Burden Added & Ratio Correction Factor



PHANTOM LOAD TESTING



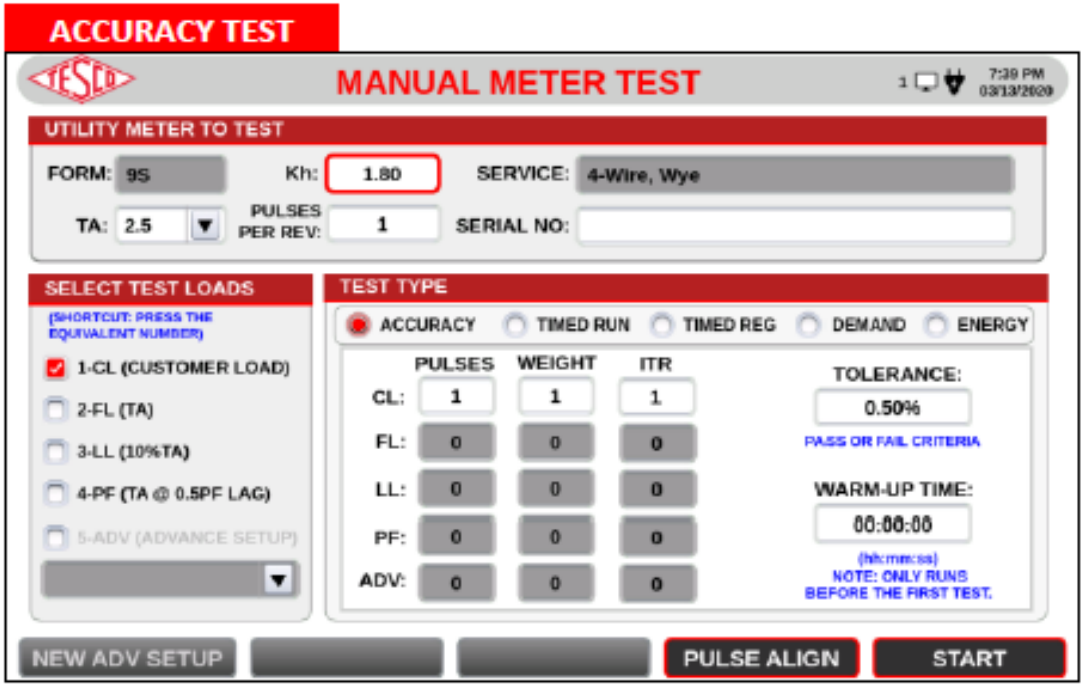
- ✓ Determine the TA (Test Amps) from Meter Faceplate
- ✓ Ensure Safety shorting switch and test jack have been disengaged
- ✓ Make connections from Field Tester to Meter Form using jumper EZ Clips.
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

THE EASTERN SPECIALTY COMPANY

PHANTOM LOAD TESTING

- ✓ Determine the TA (Test Amps) from Meter Faceplate
- ✓ Ensure Safety shorting switch and test jack have been disengaged
- ✓ Make connections from Field Tester to Meter Form using jumper EZ Clips.
- ✓ Connect IR Pulse Detector to meter output
- ✓ Check pulse indictor
- ✓ Pulse Align if necessary

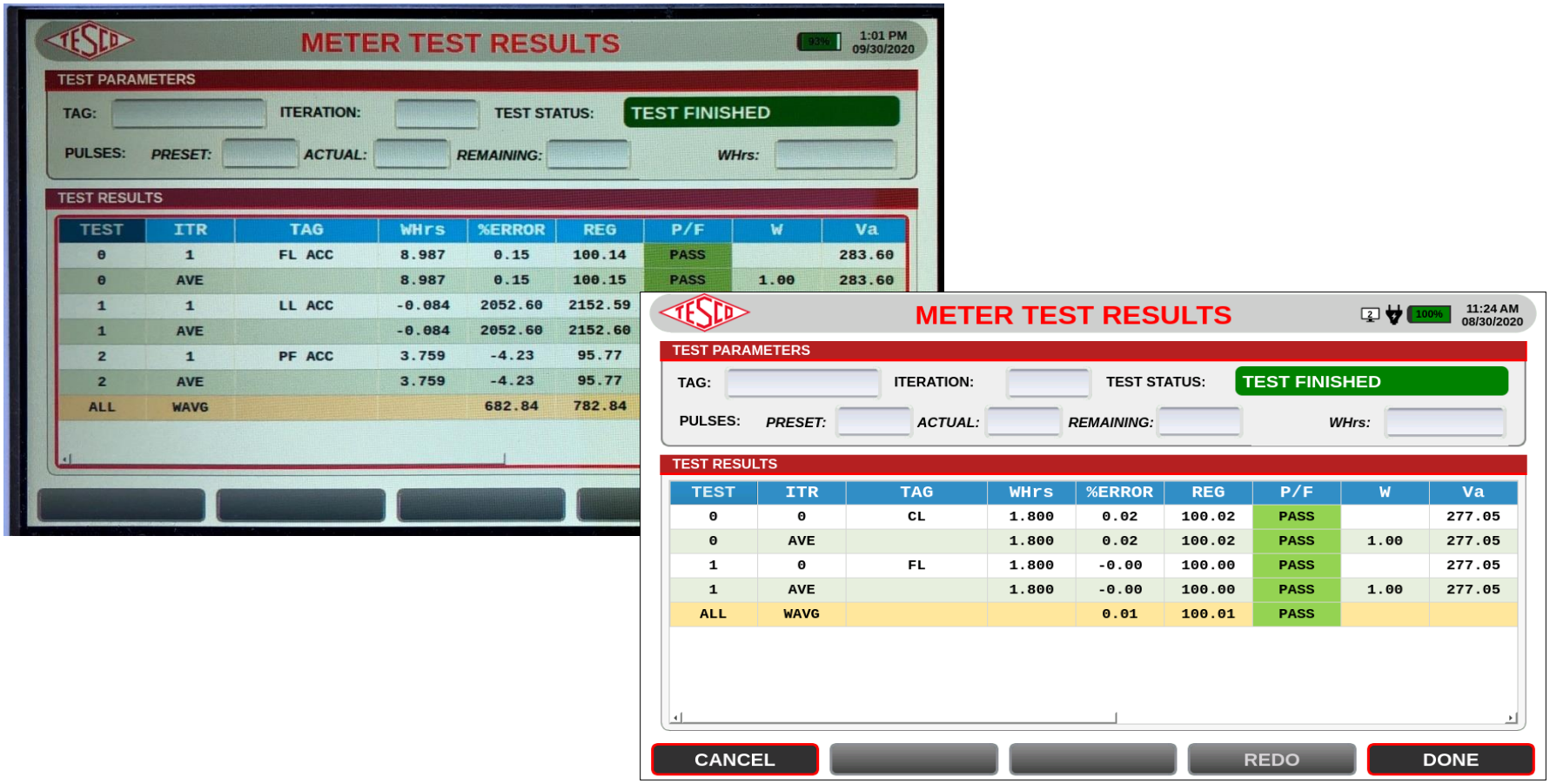
PHANTOM LOAD TESTING



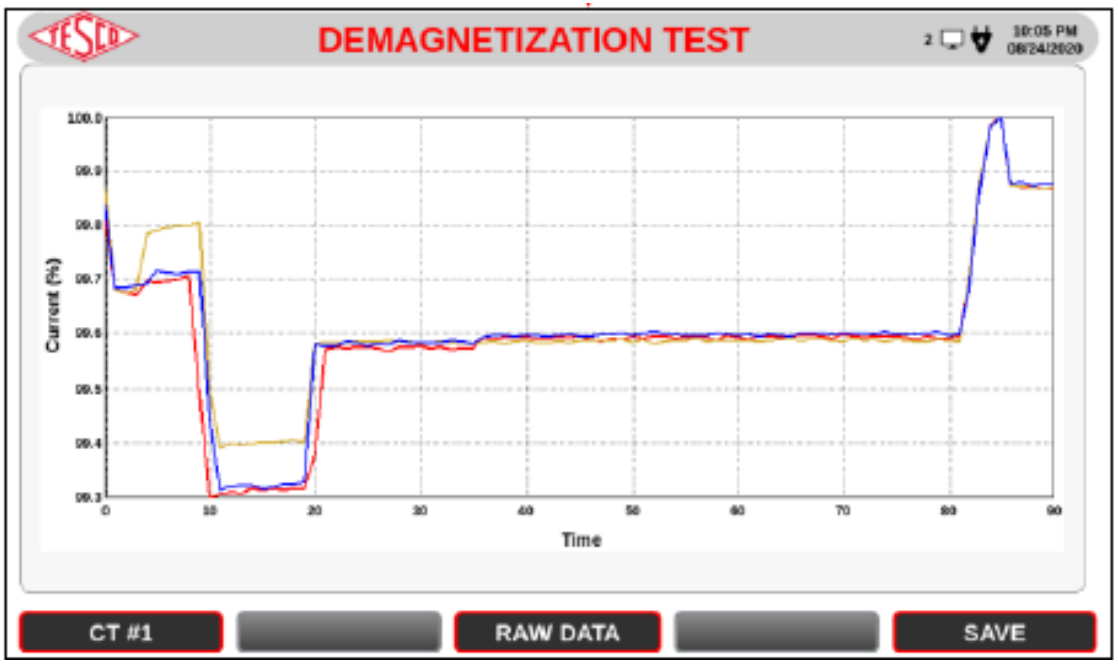
- ✓Determine the TA (Test Amps) from Meter Faceplate
- ✓Ensure Safety shorting switch and test jack have been disengaged
- ✓Make connections from Field Tester to Meter Form using jumper EZ Clips.
- ✓Connect IR Pulse Detector to meter output
- ✓Check pulse indictor
- ✓Pulse Align if necessary

THE EASTERN SPECIALTY COMPANY

PHANTOM LOAD TESTING

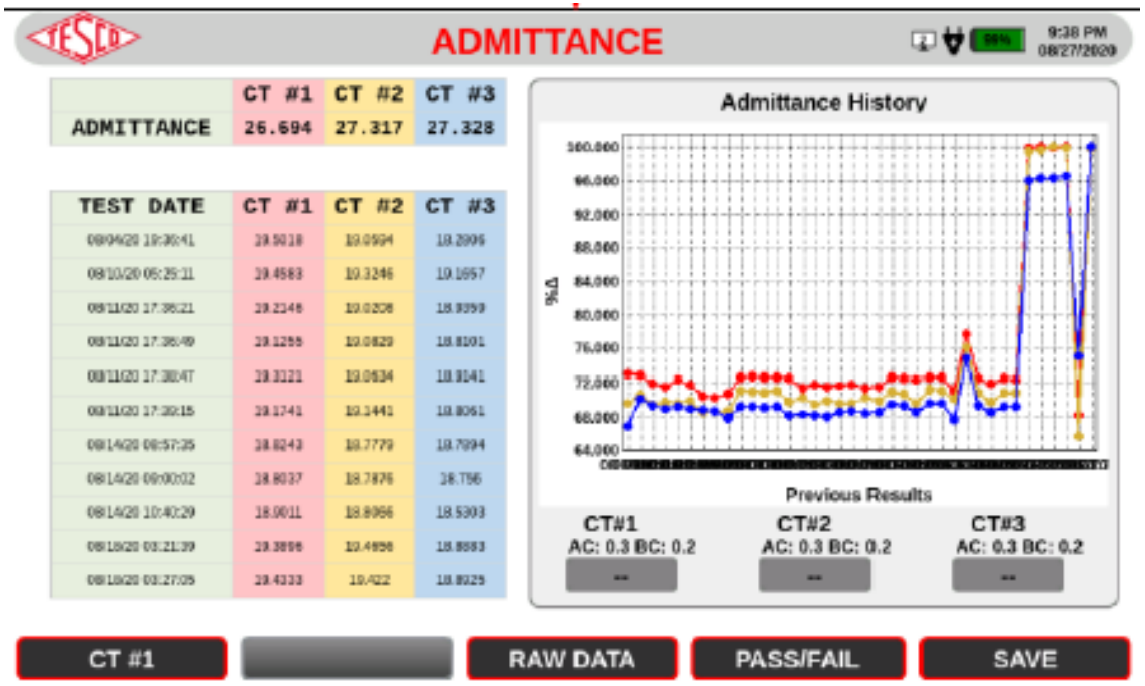


DEMAGNETIZATION TESTING



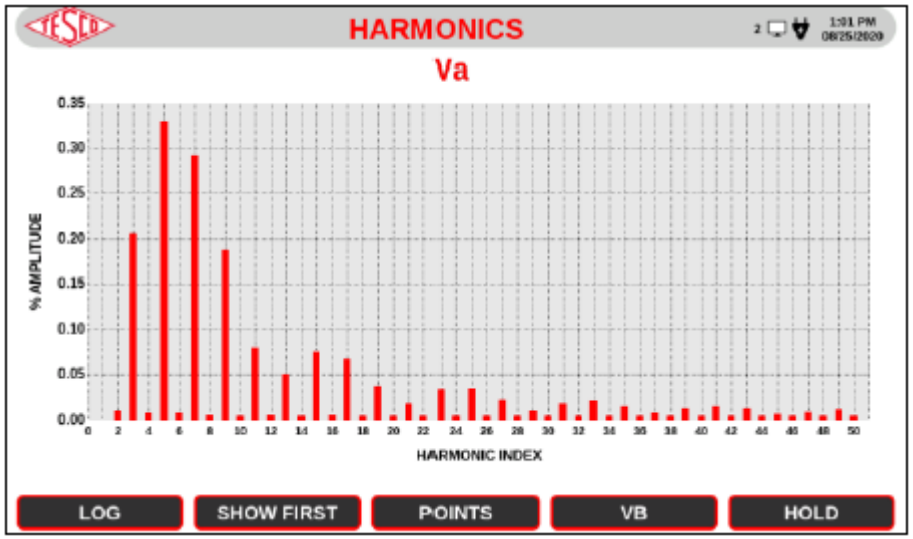
- ✓ Current transformers (CTs) show large errors when they are magnetized by dc current. This error can be reduced after proper demagnetization.
- ✓ One of the methods to demagnetize the CT is to increase the core flux by increasing its burden. This method enables to restore the nominal precision of the heavily magnetized CT from 2.5% back to 0.2% without interruption of the CT operation.

ADMITTANCE TESTING



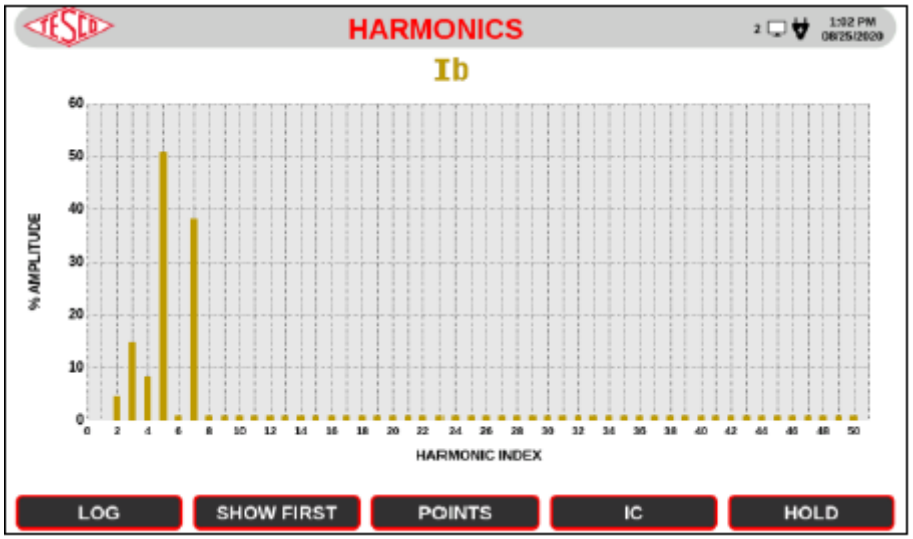
- ✓ **admittance** is a measure of how easily a circuit or device will allow a current to flow. It is defined as the reciprocal of impedance.
- ✓ The SI Unit of admittance is the (symbol S)

HARMONICS TESTING

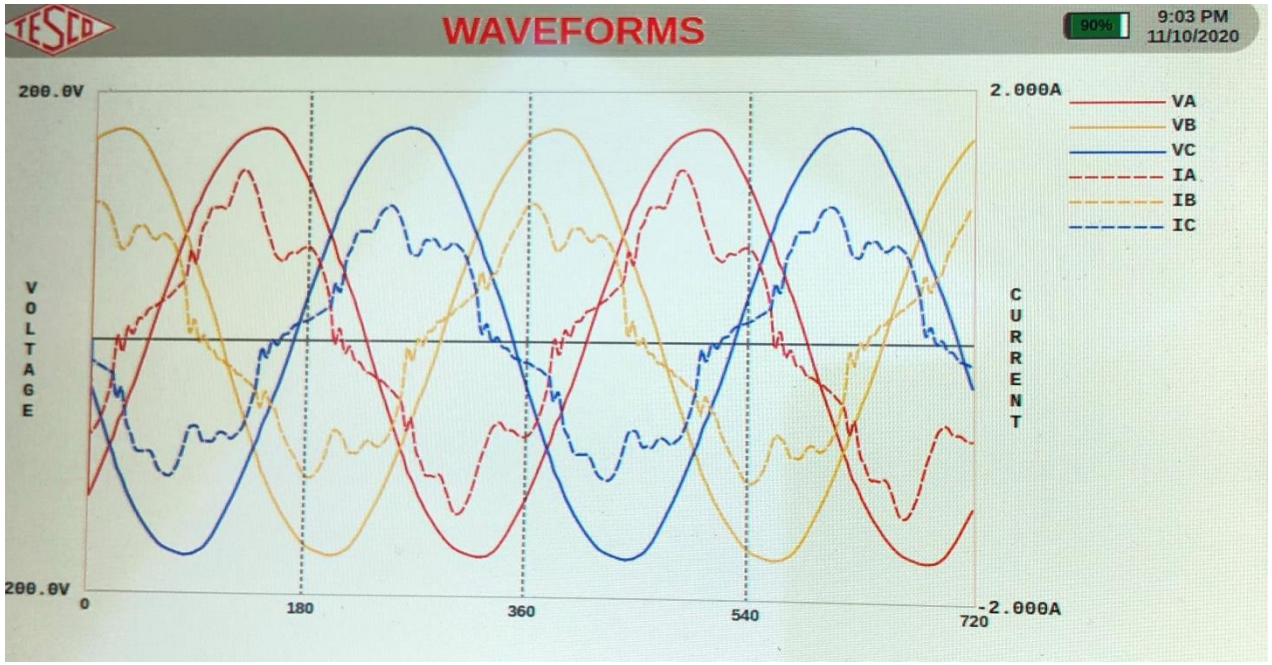


- ✓ Harmonics are integer frequencies often found with non linear loads.

THD=Total Harmonic Distortion
Vthd <5%



HARMONICS TESTING-WAVEFORMS



- ✓ **Harmonics** are generated as a voltage or current at an integer frequency of the system, produced by the action of non-linear loads such as rectifiers, discharge lighting, or switch mode power supplies.
- ✓ Harmonic frequencies in the power grid are a frequent cause of power quality problems.

HARMONICS TESTING-WAVEFORMS

What is the problem with Harmonics?

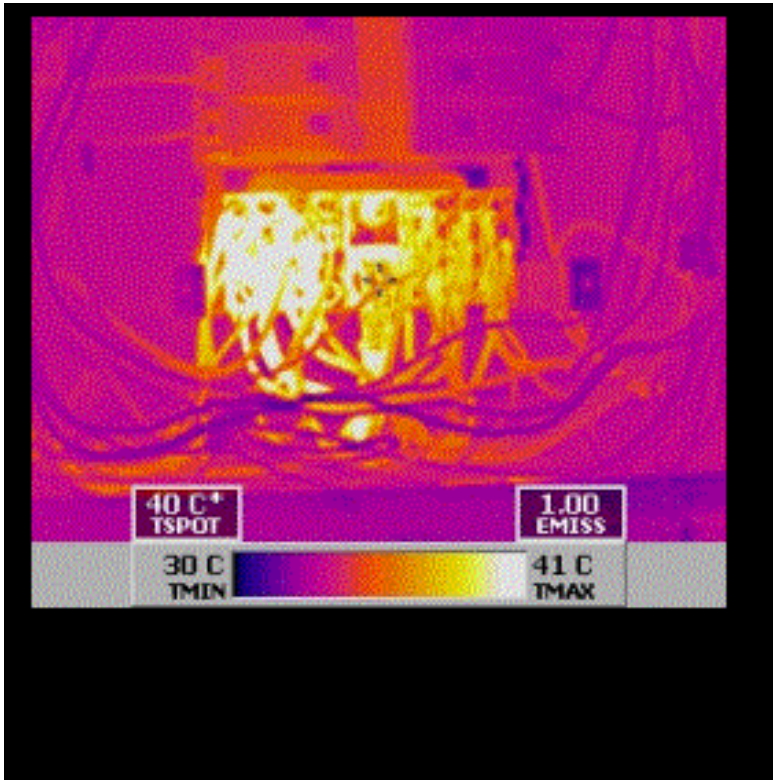


Image courtesy of irinfo.org

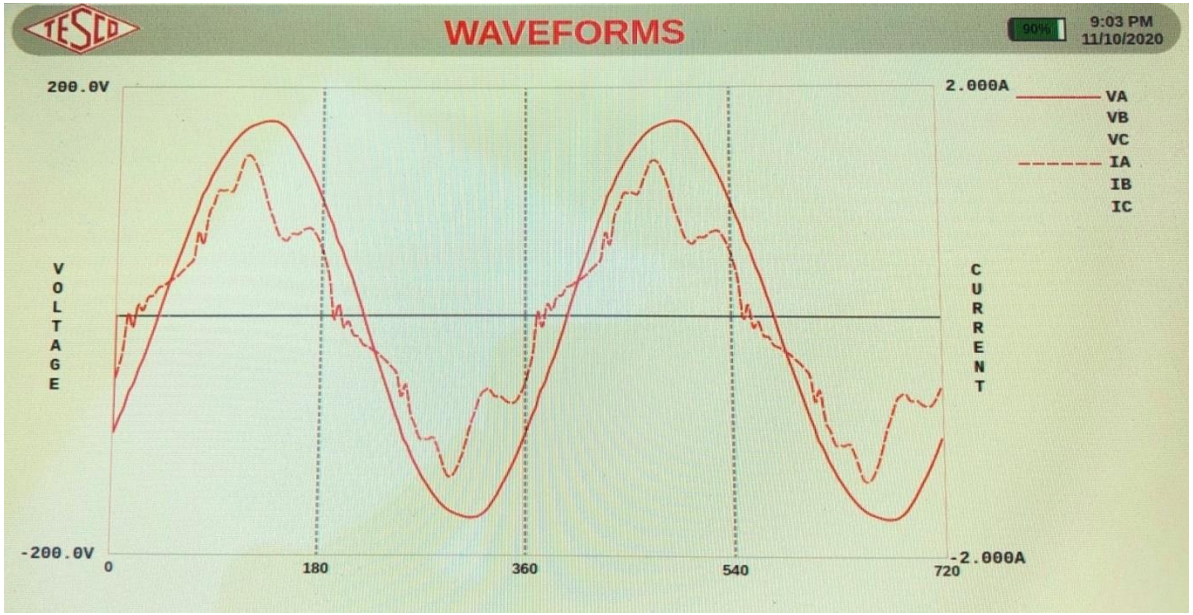
HEAT.

- ✓ Can cause significant damage
- ✓ Safety Hazard
- ✓ Poor Power Factor
- ✓ AMI Mesh Interference
- ✓ Transformer Overheating
- ✓ Loss of service

HARMONICS TESTING-WAVEFORMS

Can we reduce or eliminate Harmonics?

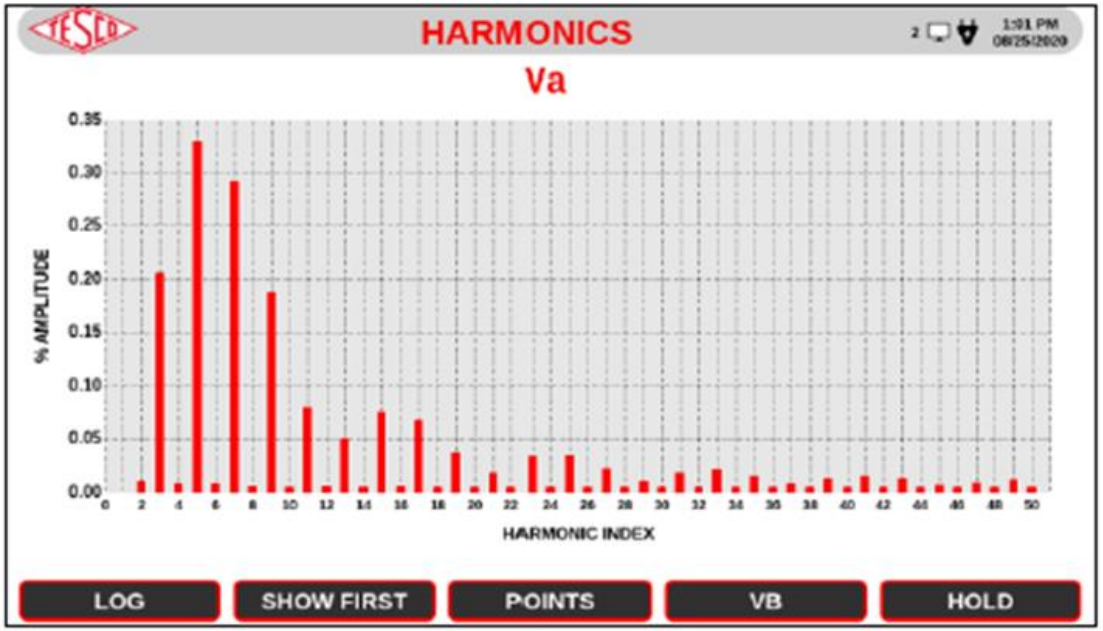
- ✓ Perhaps not eliminate. But we can reduce their impact.
- ✓ We live in non linear world of power where harmonics are generated.
- ✓ PWM conversion and AC Frequency Drive Motors and Pumps.
- ✓ Many thousands of todays electrical products have SWPS devices.



HARMONICS TESTING-WAVEFORMS

How can we reduce the impact of harmonics ?

- ✓ Measure and determine major harmonic condition under customer load.
- ✓ Assess most significant even & odd harmonics.
- ✓ Active Harmonic Filtering can reduce most significant index.
- ✓ Power Factor Correction Capacitor.



PERIODIC SITE INSPECTIONS.....

….Can Discover or Prevent:

- Billing Errors
- Bad Metering set-up
- Detect Current Diversion
- Identify Potential Safety Issues
- Metering Issues (issues not related to meter accuracy)
- AMR/AMI Communications Issues
- The need for Unscheduled Truck Rolls due to Undetected Field Related Issues
- Discrepancies between what is believed to be at a given site versus the actual setup and equipment at the site

Questions and Discussion

Tom Lawton

President

tom.lawton@tescometering.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: www.tescometering.com

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