

Non-Destructive (NDT) Examination of Wooden Poles



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Recognized by:
Professional Engineers
Ontario





Chess Engineering Co.

- A Knowledge Based, Technology Think Tank and Multidisciplinary Engineering Firm (Electrical, Mechanical and Civil)
- PEO (Professional Engineers of Ontario) Membership
- PEO COA (Certificate of Authorization) Holder with Professional Liability Insurance (General and E&O)
- Member of WSIB (Work Safety Insurance Board)

Our main expertise: (Electrical)

- Computer Modeling of the network and Arc Flash Study (by ETAP)
- Energy Saving and GHG Reduction Projects (Applied for ON Green Fund for Micro housing and EV chargers in apartments)





Canadian Energy Ventures

- *Operation, Maintenance, Asset Management Services to solar PV, Wind, and utilities (Polux5)*
- *Monitoring solutions of solar PV utility farms*
- *Thermal Inspection of solar PV, wind farms and industrial plants*
- *UAV Drone Inspection of wind farms: offshore & onshore*



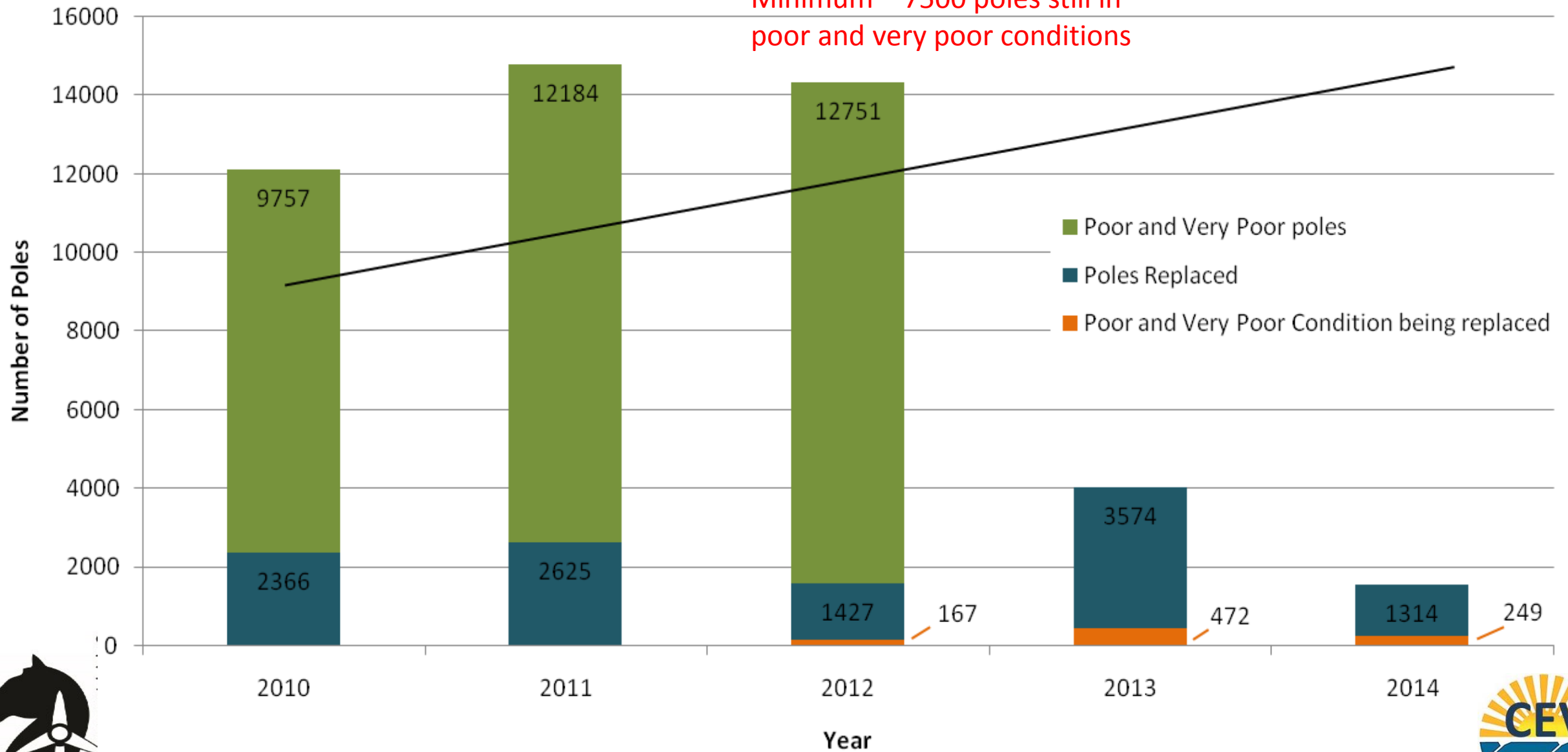
Status of Wooden Pole Assets

- Hydro poles in Ontario : 1.6mil
- Toronto Hydro (THES) owns 178,000 wooden poles; worth 900,000,000
- Replacement cost of each pole ~ \$ 7,500 CAD on average
- Average life span of each pole 50-60 years
- Average failing rate of pole strength at any given time 3-4%
- NDT examination may assess Health Index (HI) with high precision, minimize maintenance costs and down time, and increase public safety (priceless feature)



Increasing Number of Poles in Poor and Very Poor Condition

Minimum ~ 7500 poles still in poor and very poor conditions



Wooden Pole Health Assessment

- Invasive Methods
- Non-destructive Examination (NDT) Methods



Destructive Field Test

- Intrusive field inspection method
- typically involving the “sound-and-bore” process



Sound-And-Bore

Pros:

Can be done in conjunction with mitigation treatment

Cons:

Repetitive; boring can weaken poles.

Not foolproof—must drill weakest spot



Non-Destructive Test (NDT)

field inspection method that does not weaken
poles





Non-Destructive
Test (NDT)

Non-Destructive Test (NDT)

- PURL
- Resistograph
- POLUX





Non-Destructive Test (NDT)

Pros:

- Can be used frequently to track rate of decay
 - Faster and cheaper

Cons:

- Not foolproof – each technology has its limitations



Strength Measurement Units

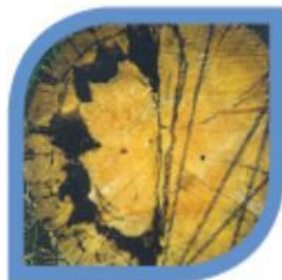
- Remaining Sectional Modulus
(RSM)
 - Modulus of Rupture
(MOR)





Remaining Sectional Modulus (RSM)

- Estimate of remaining sound wood at a localized spot on the pole is determined by measuring internal pockets and/or shell thickness
- Example: PURL, Resistograph



Actual



Prediction



Remaining Sectional Modulus

(RSM)

- Look-up tables or Pole Analysis software used to estimate the % remaining pole strength from %RSM.
- Pole analysis software can provide refined calculation of % pole usage



Modulus of Rupture

(MOR)

- Estimate of the remaining fiber strength at a localized spot on the pole (typically at the groundline)
- Example: POLUX



POLUX (5)



Modulus of Rupture (MOR)

- % remaining pole strength is directly calculated as ratio of estimated remaining strength to CSA nominal fiber strength of wood species
- Pole analysis software can provide refined calculation of % pole usage



POLUX ⑤

- Non-Destructive : it will not cause further decay
- Scientifically Developed and Proven Technology
- Objective, accurate, reliable: the POLUX offers data you can depend on
- Increase Safety and Reduce Costs
- Affordable and Efficient
- Make sound decision on replacement, planning, purchasing, maintenance, and storage.





POLUX 5



- Lighter than POLUX 4
- Quickly attaches using power screw
- Bluetooth with Android
- Designed to estimate the pole strength (MOR) at groundline



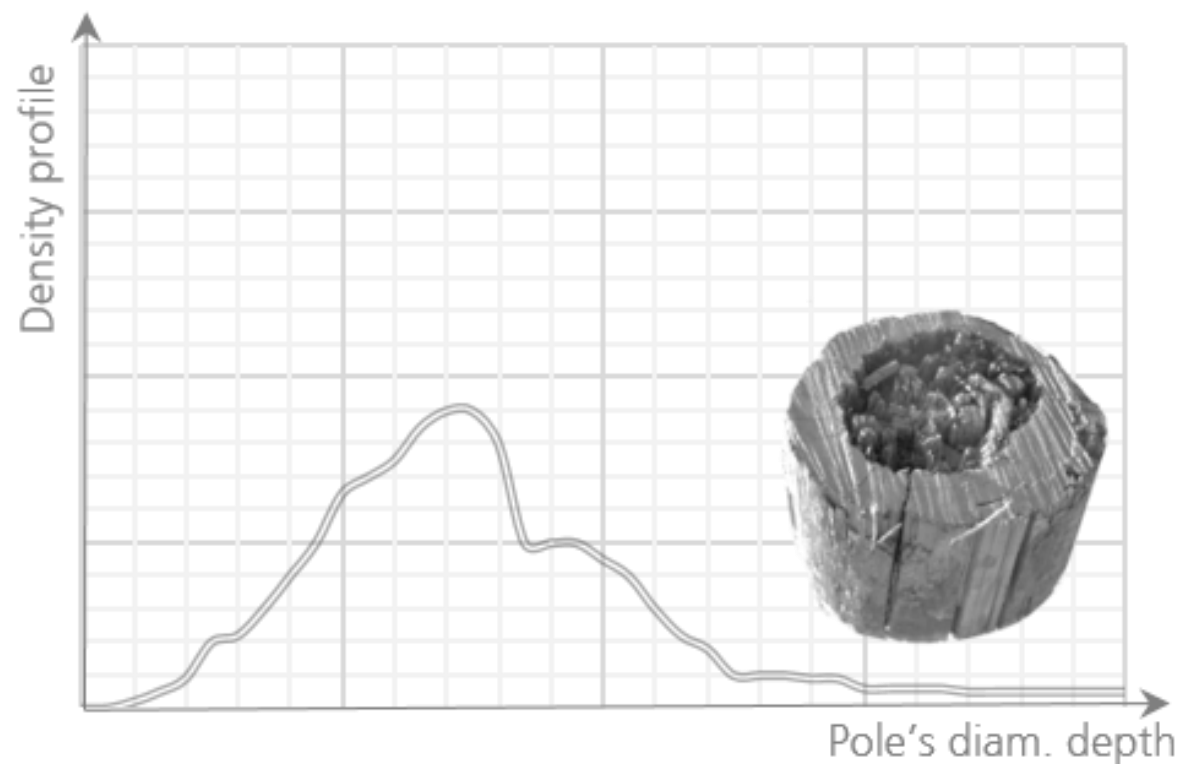
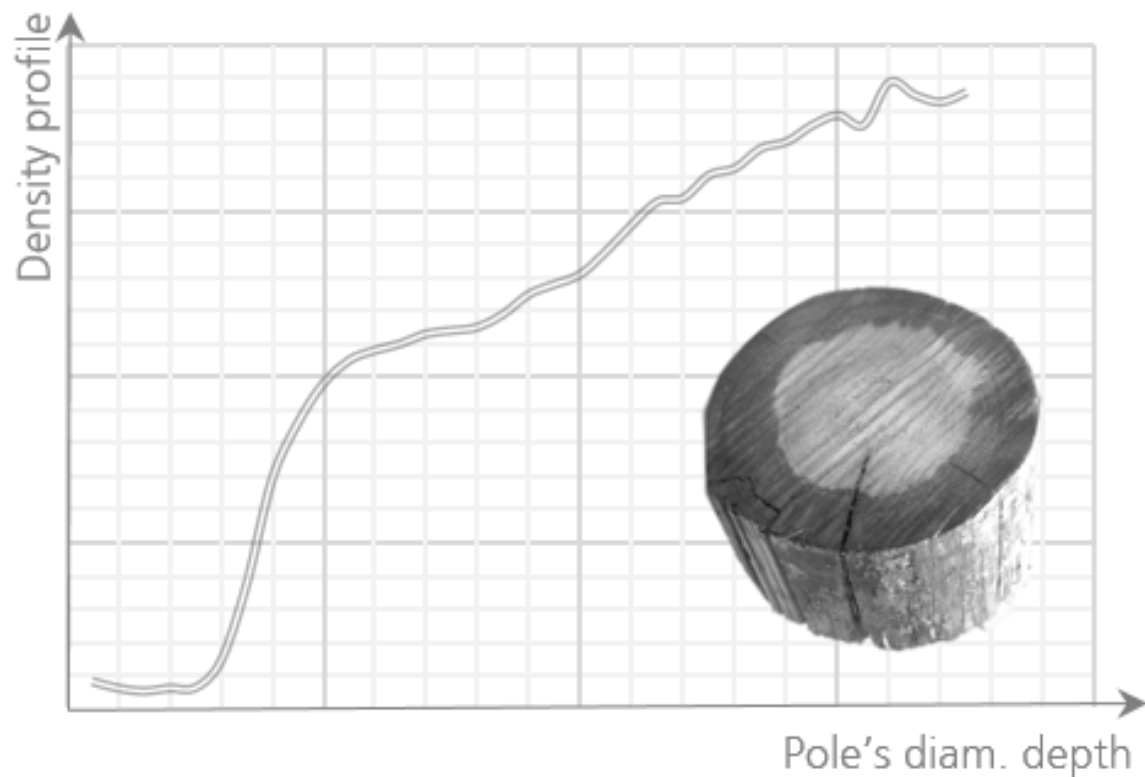
Video Time



POLUX ⑤

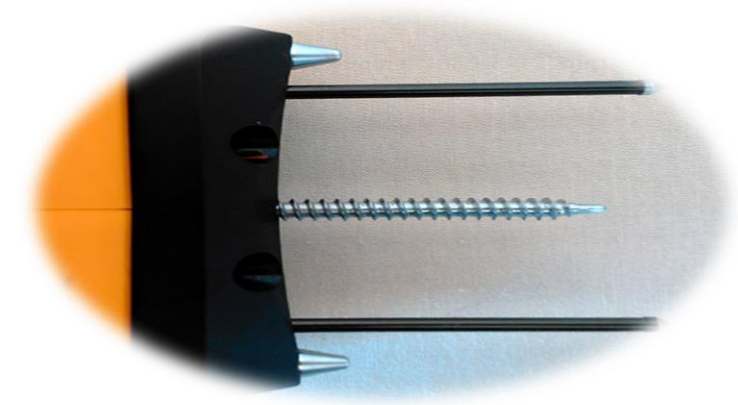


Records the wood density profile together with the moisture content to evaluate any risk of biodegradation process.



POLUX ⑤

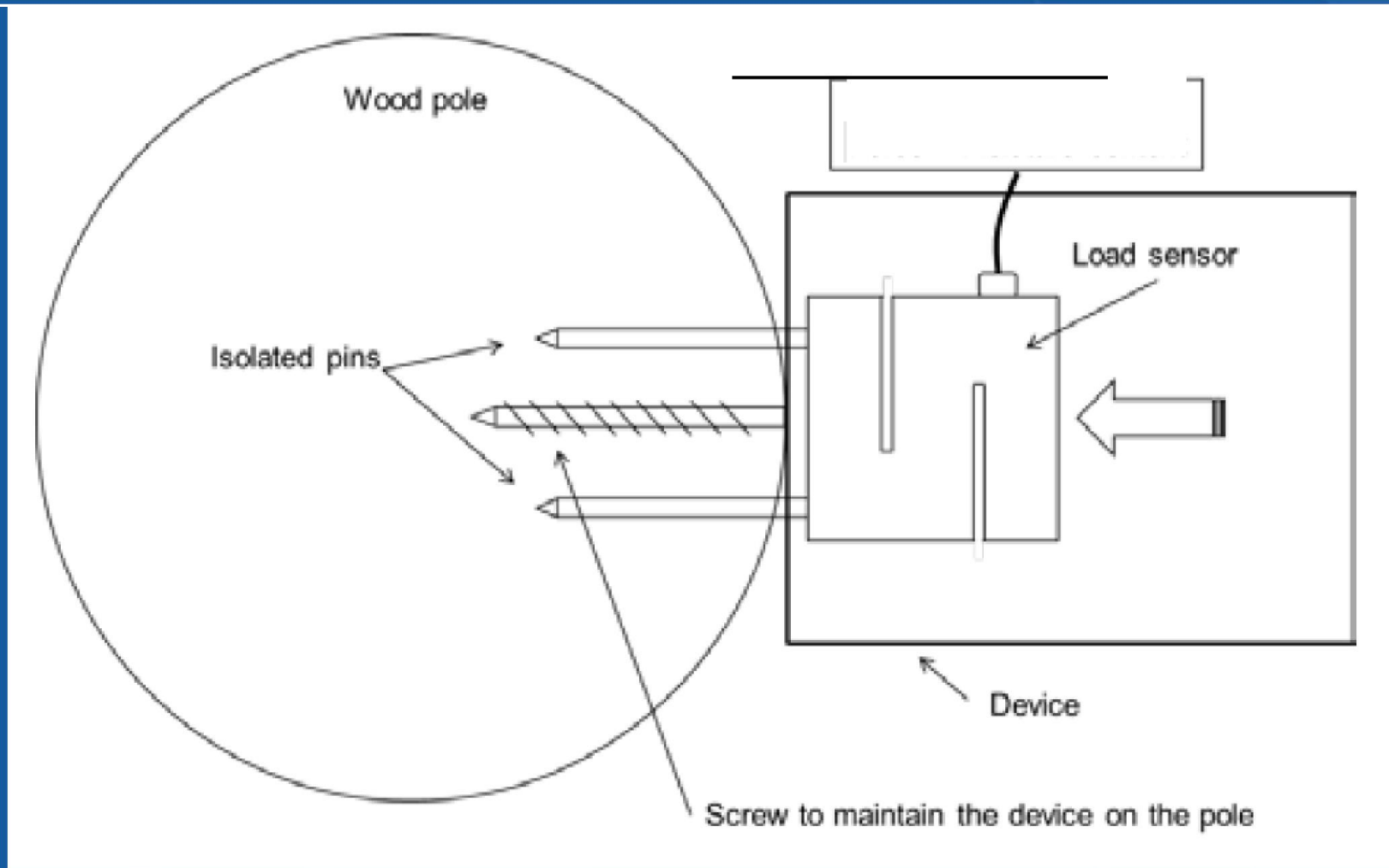
How Does it Work



- The **POLUX** utilizes two thin probes which, when inserted into the pole, measure both the moisture content and the resistance (recorded as the PSI of force) of the probes. (Insert Clip)
- These measurements help to discern the remaining fiber strength of the wood itself, which specifically speaks to the fiber strength recommendations set forth in ANSI guidelines (see ANSI publication O5.1)
- The probe measurements are combined using the PICUS software with information about the pole's wood species, age and class, along with any preservative (e.g. Penta) present to scientifically deduce the remaining strength of a wood pole.
- Whether you want distribution poles tested or transmission poles –the **POLUX** technology works on *all* poles.
- Type of the pole is an input to the device and can be changed as required. Easy.



POLUX 5

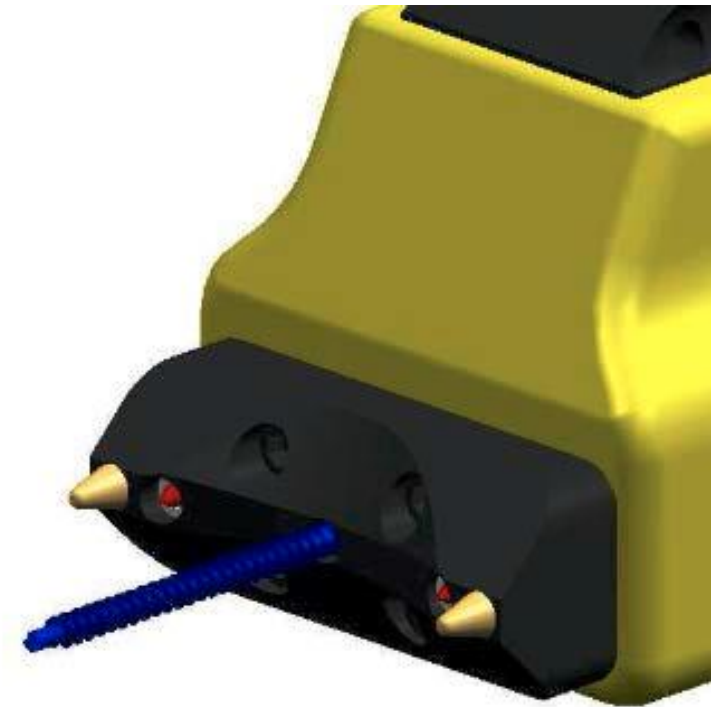
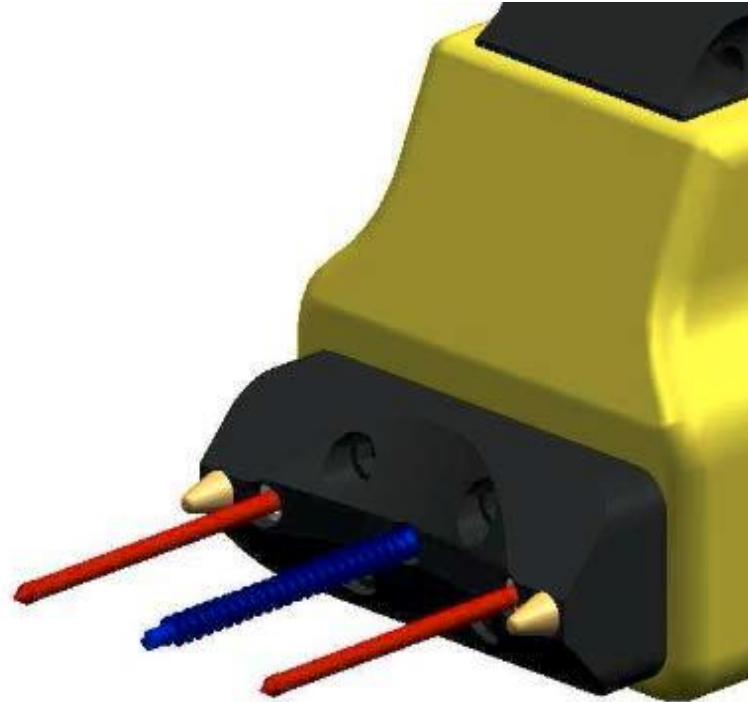
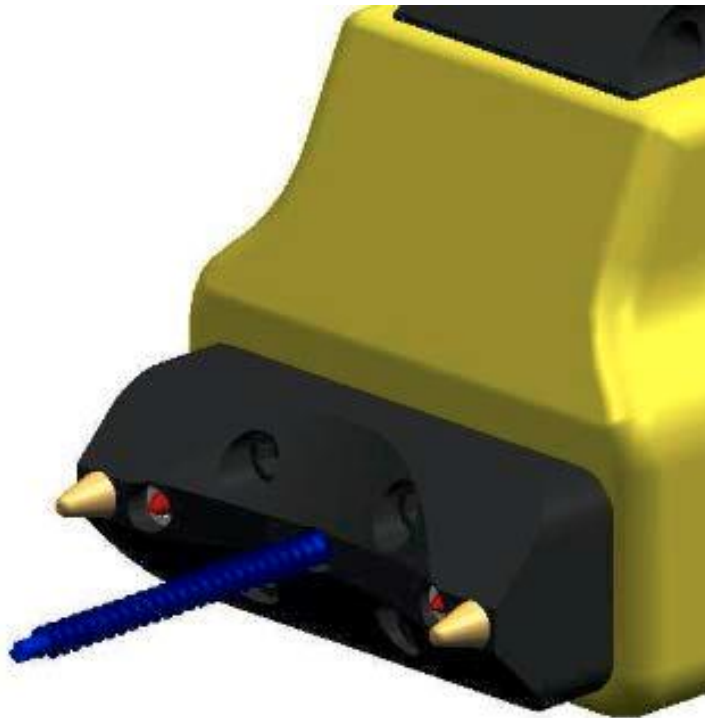


POLUX 5



POLUX ⑤

Stages of measurement Illustrated



POLUX ⑤

Measures:

Penetration resistance

Moisture content

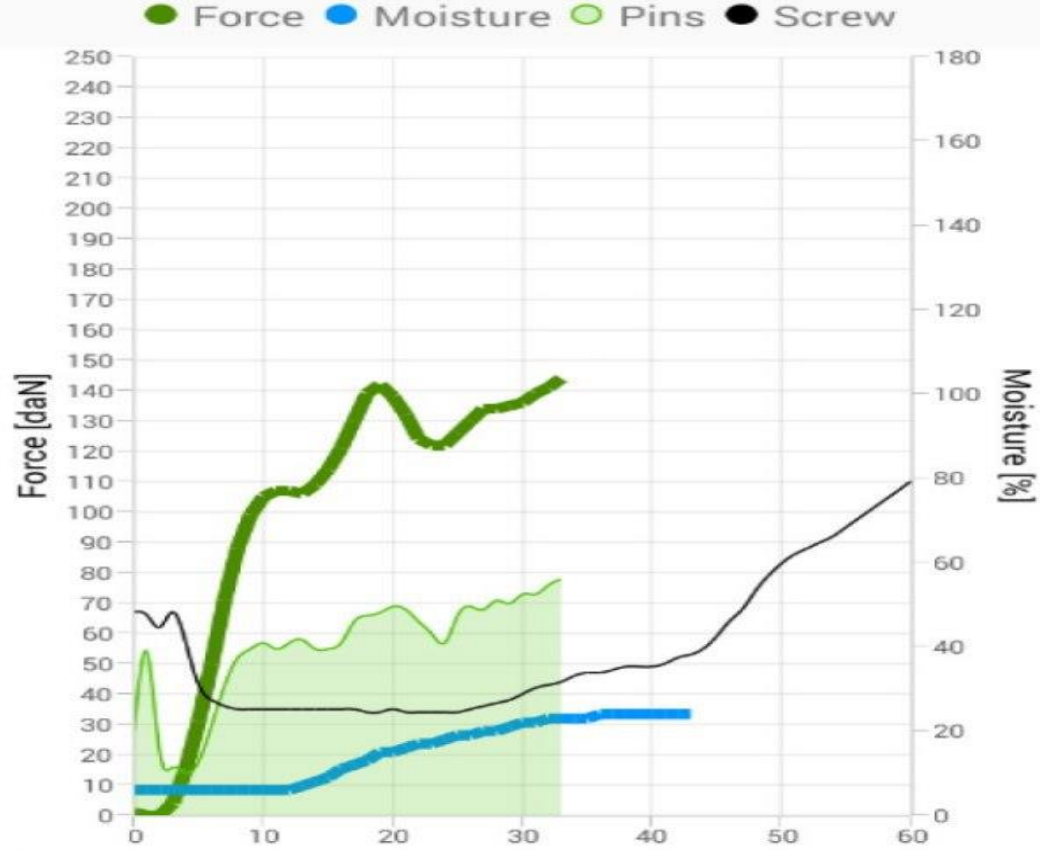
Measurement angle



POLUX 5

Graph Profiles

- Pin Force
- Pin Energy
- Screw Energy
- Moisture



Values summary

| | |
|-------------|--------------------|
| ID: | PX000017 |
| Time: | 6/24/2015 11:22 AM |
| Tilt: | 8 ° |
| Screw: | 72 W |
| Force: | 136 daN |
| Moisture: | 24 % |
| Pins power: | 70 |



Advantages of Polux 5

- As the fifth generation of this ground-breaking technology, the **POLUX 5** far exceeds both previous generations and all other testing methods currently available. **Not a prototype device.**
- The lightweight design (2.8kg) and wireless Bluetooth communication allows for convenient and fast testing. As if this were not enough, **the POLUX data provides an actual percentage of fiber strength and expected life left in a pole.** Calculations based on actual science, not on speculation.
- Our team can easily test a pole and receive reliable data in mere minutes, allowing them to know for sure if a specific pole is stable. **The ease of use allows for the testing of 75-100 (yes really, 75 to one hundred) poles per day in normal geographical conditions.**
- Easily meet federal and provincial testing and inspection guidelines well within your budget and within your timeframe. The RAW DATA is available immediately for use and INTEGRATION into the client's existing asset management database.



POLUX **5**



WHAT DATA DO POLUX 5 and PICUS Collect

- While the POLUX 5 collects the data regarding internal moisture and force resistance, the handheld-installed PICUS software allows for the ready input of any additional information through the use of pre-installed dropdown menus.
- The PICUS software is easily customizable to also add in any other observable information such as conductors, transformers, grounds, devices, meter numbers, and GPS location...
- The PICUS software can be customized to include any field collection data required.



WHAT CAN WE DO WITH ALL OF THIS DATA?

- The short answer is that you can make more informed decisions regarding every aspect of your pole inventory, from maintenance to replacement to purchasing.
- With the ability to see the data in both spreadsheet form and as a color-coded visual representation in Google Earth, you can easily spot areas requiring immediate attention and spot decay trends in remaining pole life to help you plan for your needs next year and in the years to come.
- Pole data is generally colored by percentage of remaining life (MOR), with
 - red poles at 50% or less
 - orange poles at 51%-60%,
 - yellow poles at 61% -70%,
 - green poles at 71% to 100%





POLUX 5



Screen 1 / 23

7:34

General

ok

Inspector's name:

AR

Date of inspection:

2/9/15

Company:

DPPD

Sub number:

23

Feeder number:

1

Rem

Screen 20 / 23

7:35

Polux results

ok

Nominal value (SP): 8,000 [PSI]

Strengths: I: 6,369 II: 6,387 [PSI]

Estimated residual fiber strength: 6,378 [PSI]

Percentage remaining fiber strength:

0% 80% 100%

Pole strength (MORGL) including external defects: 6,378 [PSI]

Percentage remaining pole strength (MORGL) including external defects:

0% 80% 100%

Pass test

Fail test

Rem

POLUX 5

Sample Data Output

| Identification | | | | Polux measurement | | | | | | | |
|----------------|------|------|-------------|-------------------|---------------|---------|----------------|---------------|----------|---------------|---------|
| ID | Zone | Line | Pole number | Device | Measurement 1 | Force 1 | Moisture 1 [%] | Sigma 1 [PSI] | Result 1 | Measurement 2 | Force 2 |
| 1 | Test | 1 | 1 | PX05-02-0020 | PX000052 | 123 | 4 | 56.7 | Green | PX000053 | |
| 2 | Test | 1 | 2 | PX05-02-0020 | PX000054 | 123 | 4 | 56.7 | Green | PX000055 | |





Conclusion of NEETRAC Project comparing various NDE methods on Health Assessment of in-service wooden poles:

“The analysis concludes that the POLUX results meet the standard of scientific rigor with a 95% significance rating. On the basis of the objective performance against the criteria developed prior to the field inspection, the POLUX device appears to represent an advance in the state-of-the-art wood pole diagnostics.”

Wood Pole In-Service Assessment Methods

NEETRAC Baseline Project Number: 05-250

September, 2008

Georgia Tech Research Corporation



References

- CSA O15-05
- CSA C22.3
- ANSI O5.1
- Toronto Hydro Annual Information Form 2017
- Measurement of Wood Pole Strength, IEEE
- Polux5 Specifications
- Wood Pole In-Service Assessment Methods, *NEETRAC, Georgia Institute of Technology*



Utilities using *Polux* Worldwide:



Thank You!

To arrange for your next wooden pole NDT using Polux 5 Technology, do not hesitate to contact us:

