

---

## The Canary System: Frequently Asked Questions

### What is the technology behind The Canary System?

The Canary System directly assesses the status of the enamel crystal by using PTR-LUM technology. Pulses of laser light are shone on the tooth and the laser light is converted to heat (Photothermal Radiometry or PTR) and light (luminescence or LUM) which are emitted from the tooth surface when the laser is off. The Canary System measures four signals:

1. The strength or amplitude of the converted heat or PTR signal;
2. The time delay or phase of the converted heat or PTR to reach the surface;
3. The strength or amplitude of the emitted luminescence (LUM);
4. The time delay or phase of the emitted luminescence (LUM);

The Canary Number is created from an algorithm combining these four signals and is directly linked to the status of the enamel or root surface crystal structure and not on bacteria.

These harmless pulses of laser light allow one to examine up to 5 mm below the tooth surface. Carious lesions modify the thermal properties (PTR) and glow (LUM) from the healthy teeth. As a lesion grows, there is a corresponding change in the signal as the heat is confined to the region with crystalline disintegration (dental caries) and PTR increases and LUM decreases. As remineralization progresses and enamel prisms begin to reform their structure, the thermal and luminescence properties begin to revert back in the direction of healthy teeth. The system is so sensitive it detects very small changes in temperature (less than 1 – 2 degrees Celsius), much less than that generated by a conventional dental curing light and imperceptible to the patient. Our two Health Canada clinical trials have confirmed the safety of The Canary System.

### Is it called “Energy Conversion Technology” or “PTR-LUM”?

We describe PTR and LUM as “*energy conversion technology*”. The Canary System monitors heat and light that result from the exposure of the tooth surface to laser light. We are not looking at reflection or the glow from bacterial by-products but actual conversion of energy. The incident laser light is absorbed by the carious lesion and subsequently converted into two forms of energy--heat and glow or luminescence. When the laser is off, the heat and glow are emitted back from the tooth to The Canary System. As a lesion grows beneath the surface, there is a corresponding increase in heat and decrease in luminescence. In contrast, as remineralization of the lesion progresses, there is a corresponding decrease in heat and increase in luminescence. This is how The Canary System measures and monitors the status of the crystal structure.

### Why is it that if I perform several scans on tooth surface I may not get the same Canary Number?

As the laser pulses at 2 Hz, it directs a beam that is .05 mm in diameter up to 5 mm below the tooth surface. The Canary System is able to pick up information from a hemispherical area beneath the laser beam that is 1.5 mm in diameter by 5 mm in depth. This means that when scanning, if the hand piece is oriented in a different angle on the tooth surface, one will be measuring a different section of the tooth. For healthy enamel this may make the numbers vary slightly over the healthy range but for early lesions and frank cavitation the numbers may vary over a larger range, as one examines different sections of the lesion. Canary Number differences of <10 may be typical in these situations.

### Why would an open, carious lesion only have a Canary Number of 50?

The Canary System is designed to measure defects in crystal structure by looking at the reflected heat (PTR) and glow (LUM). In an open, active lesion with soft brown or black debris on the surface, we are not measuring defects in crystal structure but infrared (PTR) and glow (LUM) from this soft debris. At times, this debris may not yield very high heat (which produces infrared emission) thus resulting in a lower Canary Number. Frank cavitation is visually easy to detect and diagnose. If you remove the soft debris from the lesion, The Canary System can then measure the degree of demineralization in the remaining tooth structure beneath the soft debris.

### **Does healthy cementum or root surface affect the Canary Number?**

Our Canary Scale was developed from studies on enamel surfaces. Cementum and root surfaces are not as heavily mineralized as enamel. This means that the root surface will absorb more of the IR energy and convert it to heat which will yield a higher Canary Number. Healthy root surfaces especially those with a dark brown colour will have a Canary Number that is higher than 20. When scanning a root surface, it is essential to keep the surface dry and note the colour before making any clinical treatment decision. The Canary System can still monitor changes as the root surface remineralizes but the healthy root surface may fall outside the range for healthy enamel.

### **What is the difference between, "movement detected" and "rescan" or "repeat"?**

During a five second scan, The Canary System is continuously measuring PTR and LUM responses from the tooth surface. It is analyzing the four signals coming back from the tooth surface every second and averaging response signals to calculate the Canary Number. If these response signals vary beyond the acceptable standard deviation then The Canary System would report movement detected and will ask the operator to rescan the surface. Movement of the handpiece will occur if there is not a stable and firm contact on the tooth surface during the five second scan.

"Repeat" feedback after scanning a tooth surface means no response signals were detected during the scans. This might happen when users tried to scan a deep cavity or interproximal area but the laser was out of focus because of the geometry of the area. In this situation the response signals from the scanned area would be insufficient, and The Canary System would request that the user "repeat" the scan.

### **Why do I still get a Canary Number even though there was obvious movement of the handpiece along the tooth surface?**

If the PTR and LUM values collected during the five second scan fall within an acceptable standard deviation then there would be sufficient information to output a Canary Number. In other words, the scanned enamel surface upon which the handpiece was moved is very uniform in the health of that surface.

### **How do you detect interproximal lesions?**

The Canary System involves a point scan of a region of a tooth surface. The Canary System will typically gather information from a hemispherical area that is 1.5 mm in diameter by 5 mm in depth. This means that it can detect carious lesions and defects that fall within this column. If there is a large lesion with a stained pit or surface then The Canary Number will be very large, typically approaching 71 – 100. If the lesion is located beneath an intact enamel surface, the Canary Number will be smaller but definitely above the 0 – 20 range.

Interproximal lesion detection involves examining a contact point from three different directions to see if there is a lesion in this area. The location and size of the lesion will determine the size of The Canary Number. If the lesion is small (approximately 0.5 mm.) and located right in the centre of the contact region beneath 3 mm. of enamel, it may be very difficult to detect. Detection will involve carefully scanning from the buccal, lingual and occlusal surface at this contact point or region.

### **How will plaque, biofilm and stain affect The Canary Number?**

Our investigational studies have shown that biofilm and plaque do not affect The Canary Number. If there is a build-up of food debris on the tooth surface, it can simply be removed with a cotton swab before starting to scan the tooth surface. There is no need to prophylax or polish the tooth surface if the food debris can be removed with a tooth brush or gauze square. Very heavy brown stain (e.g. "smoker's stain") will affect the Canary Number, but very mild stain has very minimal to no effect.

### **Which Canary Number does the software save?**

Repeat measurements take only 5 seconds just to verify your reading. When using the "Detail Scan", The Canary System saves the last Canary Number reading for each scanned region on a tooth surface. The Canary Numbers along with the image of the scanned regions can all be viewed in the History of a patient profile. When using the "Quick Scan", the five most recent scans are displayed in a column on the right side of the monitor. However, Canary Number readings obtained using Quick Scan are not saved by The Canary System.