

# SL-RAT FAQs

## InfoSense SL-RAT® Acoustic Pipe Inspector – FAQs

### **Q1: How does the SL-RAT acoustic inspection technology work?**

A1: Our technology relies on the fact that sound traveling through air mimics the flow of water through a pipe. We use an active transmitter – think of it as the part “yelling” down the pipe, coupled with a receiver – the “brain” that uses sophisticated algorithms and a patented process to interpret blockages based on what it “hears” coming through the pipe.

### **Q2: What are the benefits of acoustic technology over existing pipe inspection methods such as pole (zoom) cameras or CCTV?**

A2: The SL-RAT can provide a blockage assessment 10-20x faster than CCTV, for less than 1/10<sup>th</sup> to 1/20<sup>th</sup> the cost per foot, and without the need for pre-cleaning or contact with the waste flow. The SL-RAT is best for quick and low-cost screening of small diameter pipes, but is limited to pipes under 18 inches in diameter. On the other hand, a zoom camera’s sight distance is greatly limited by small-diameter pipes. To see a comprehensive comparison between pole (zoom) cameras, CCTV and SL-RAT technologies, [click here](#).

### **Q3: What exactly does the device measure?**

A3: It measures the dissipation of sound energy through the airspace within the pipe between the sewage flow and the pipe wall. The more aggregate obstructions within the pipe – such as roots, grease, debris, joint offsets, “hammer tap” lateral connections, etc. – the more the sound energy is blocked. Our device measures this “energy gap” and then develops a blockage assessment. The assessment uses a proprietary algorithm based on a statistical model of sound behavior in conduits that was developed through several years of empirical research in sanitary sewer lines.

### **Q4: If it is measuring blockage in the “free space” above the flow of water in the pipe, how does the algorithm deal with pipes that are at >75% of capacity?**

A4: As the free space in the pipe becomes more constricted by the water flow so will the acoustic signal used to measure the available excess capacity within the pipe. Simply put, as the water level increases above 75%, the blockage assessment will tend to decrease until at full pipe the assessment is zero. That being said, our experience has found it very rare to have a small diameter gravity-fed sewer pipe that continuously remains in that flow volume range – when that is occurring it typically points to pipe capacity issues which the SL-RAT® can indirectly detect.

### **Q5: Can your device pinpoint where a blockage is and what it is?**

A5: The SL-RAT® is a rapid assessment tool that is designed to quickly identify “problem” segments. Once a blockage is detected with the SL-RAT®, a more detailed method such as CCTV should be focused to learn more details about the potential problem.

**Q6: What is the maximum segment length the SL-RAT® can reliably measure across?**

A6: Depending on ambient noise levels, our customers have obtained measurements reliably up to distances of 800 feet (240 meters).

**Q7: What kind of pipe does the SL-RAT® work in, and does pipe geometry matter?**

A7: The SL-RAT® is tuned for use in 6 -12" (150mm-300mm) diameter unpressurized collection pipe with a flow-level capacity at measurement that is below 90% of capacity. Since the SL-RAT® uses sound energy to detect blockages, it can go around turns and flow over obstacles – unlike CCTV. The type of pipe does not matter –although clay pipe with significant joint offsets will typically generate lower acoustic scores relative to other types of pipe such as cast iron and PVC.

**Q8: What are the pipe size limitations of the technology?**

A8: The recommended pipe diameter is 6 – 12" (150 to 300mm), and the scoring algorithm is based on this range of pipe diameter. It is possible to use the technology up to 30" (750mm) in diameter, but it is not recommended, and should only be used when other inspection methods are not available. Also, at larger diameters, it is important to establish a baseline acoustic score and then look at variations, rather than solely relying on the score obtained.

**Q9: What is the effect of lateral connections and/or capped laterals?**

A9: The SL-RAT® is designed to operate in pipes with lateral connections, even in residential areas. An excessive number of lateral connections, especially capped laterals, can reduce the amount of sound energy that reaches the receiver, hence resulting in a lower acoustic score. Additionally, more sound will “leak” up larger laterals so scores may be slightly lower in sewer lines that connect to 6" (150mm) laterals versus the more standard 4" (100mm).

**Q10: Does the depth of the manhole affect the measurement?**

A10: No. We have run tests to depths of 35 feet (12 meters) and found no appreciable loss in measurement quality

**Q11: Can multiple SL-RAT® receivers (RX devices) be connected to one SL-RAT® transmitter (TX device)?**

A11: No. While technically possible this would require an additional device and person, and the equipment is not setup to handle multiple receivers. In practice, the inspections are completed so quickly that our customers have found very few practical field situations where it would make sense economically to use multiple receivers with one transmitter.

**Q12: Does background noise affect the performance of the device?**

A12: If the receiver (RX) is unable to hear because of excessive background noise such as passing train or major highway traffic, it will indicate “NOISE” at the end of the test. This is a rare occurrence, and is usually corrected by switching the positions of the RX and TX unit, or by running the test at a time when the background noise is lower.

**Q13: What is the accuracy of the GPS in the devices?**

A13: The devices use a high-quality GPS chip, which is nominally rated for +/-15 feet (5-meter accuracy). Practically speaking, we do find the accuracy can be lower than you would typically see in a handheld device due to the SL-RAT®'s proximity to the ground and the fact that the chip is located inside a weather proof box. In certain situations, it is possible to see significant errors in the GPS readings (100 feet or more), so we recommend writing down the asset ID or marking test locations with SL-RAT measurement ID and acoustic score on a map or handheld device while making acoustic measurements.

**Q14: Can it detect or measure debris under the water flow?**

A14: The blockage assessment is primarily based on the air gap above the flow. The assessment can be impacted by debris under the flow, if the debris causes a “bump” or splashing water in the flow or in the case of sediment if it causes a rippling effect in the water. If the sediment level in combination with the wastewater flow above it leads to a pipe that is in the range of 75% or more full, then the SL-RAT® score may be lowered (see question on “Free Space” above for more detail on this aspect). That being said, the SL-RAT does not see below the water level and will not directly estimate the amount of sediment or debris in a sewer line.

**Q15: How repeatable are the measurements?**

A15: The blockage assessment resolution (0 to 10 scale) has been well matched to the measurement repeatability and accuracy. More technical information is available upon request.

**Q16: What is the likelihood of getting a false positive – i.e., what is the likelihood the device will say a pipe is clean when it is in fact blocked?**

A16: The measurement algorithm has been designed to be conservative, i.e., if it errors, it will declare a pipe to be more obstructed than it actually is. This has been proven to be the case in head-to-head comparison studies with CCTV and the SL-RAT® acoustic inspection. The beauty of the design is that obstructions that block water flow also block sound.

**Q17: How could we incorporate the SL-RAT® into our maintenance and cleaning program?**

A17: Our customers typically use a dedicated two-person SL-RAT® crew to quickly assess a subdivision or basin for dirty segments and blockages. The assessments can then be used to focus on the specific “problem” segments for further detailed CCTV inspection, repair, or cleaning. Our customers have found that the SL-RAT tool can typically focus cleaning activity in most basins to less than 50% of the segments while not degrading SSO performance.

**Q18: How long does it take to do a measurement?**

A18: An assessment of pipe blockage for a sewer line segment is typically attained in less than 5 minutes after the manhole covers are removed. The actual measurement time is between 1.5 to 3 minutes, depending on the number of test cycles the device performs (this is done automatically). A two-person crew can typically inspect 50-60 segments, averaging 8,000 – 10,000 feet (2,500 – 3,000 meters) of pipe per day independently, and without the need of a cleaning crew for support. Depending on topography, traffic control needs, and the ease of finding manhole lids, our customers have found it possible to inspect up to 6 miles (9000 meters) per day.

**Q19: What is the cost to operate the device?**

A19: We have found on average the device costs less than \$0.10/foot (\$0.30/m) for inspection – including a two-person crew and a service vehicle. Operating costs depend on labor rates and productivity and can vary from \$0.05/ft to \$0.15/ft (\$0.15/m to \$0.50/m).

**Q20: What type of battery do the devices use and how long do they last?**

A20: Both the receiver (RX) and transmitter (TX) use a lithium-ion battery, similar to a laptop battery but with a higher rate of discharge. Both devices have the same battery, the TX device uses the most power and is rated for approximately 50-80 measurements per battery charge. In terms of overall battery life, we expect the batteries to last several years (the batteries are replaceable). The RX unit uses very little power by comparison, and can last up to a week on a single charge.

**Q21: Is hearing protection required to operate the SL-RAT®?**

A21: No. The transmitter (TX) operator is exposed to 85 to 88dBA for 3 seconds during each tone sequence. Even during the heaviest work day this equates to approximately 24 minutes total, 10.6 hours are permitted by OSHA standards. Additional documentation on this is available upon request. That being said, most operators like to wear ear buds as listening to the repeating tones can become monotonous.

**Q22: Can the devices be used in inclement weather?**

A22: Yes. The devices are designed to be used outdoors in the rain. We do not recommend submerging the units, but they are sealed and weatherproofed, so they can be splashed with water. They are also rated for operation from 0 to 140° F (-18 to 60° C).

**Q23: Do we need to shut down or reduce the flow through a pipe prior to using the SL-RAT®?**

A23: There is no need to take the line out of service when making measurements. In other words, the SL-RAT® does not impact normal collection system operations.

**Q24: What is the recommended procedure for advancing to the next pipe segment?**

A24: It is possible to “inchworm” or “leapfrog” from one segment to the next. We recommend the “inchworm” method, each operator advances their device to the next manhole after a measurement is performed, rather than one operator staying stationary and the other operator skipping over them to the next manhole (“leapfrog”). The data are easier to process and manage when collected in this fashion.

**Q25: What is the impact of using the technology with a drop manhole?**

A25: A drop manhole can reduce the overall score, especially if it is an intermediate manhole. Recommended operation is to have the transmitter (TX) placed at the drop manhole.

**Q26: Can the acoustic sound be heard inside residential homes or businesses?**

A26: Possibly. Sound levels are not a concern from a safety perspective, but if there is a dry trap or connected air space from the mainline through the lateral, it is possible that the tones could be heard. This is quite a rare occurrence.

**Q27: What does a “CLOSE” reading mean on the SL-RAT® device?**

A27: If the receiver (RX) and transmitter (TX) are within 50 feet (15 meters) of each other, it is possible that a higher acoustic score could be due to hearing the tones over the air, instead of through the pipe. The device is designed to issue a cautionary warning that this could be occurring. If there are GPS or intradevice communication issues due to the environment, this could occur even when the devices are farther apart. If you receive a high score and the devices are within 50 feet of each other, then it is recommended to obtain one measurement for the short segment, then another acoustic measurement with an intermediate manhole in between.

**Q28: Is it possible to skip manholes while doing acoustic inspections (perform an acoustic inspection of a segment with an intermediate manhole in between)?**

A28: The recommended method of inspection is to have the receiver (RX) and transmitter (TX) on adjacent manholes. There are some exceptions to this. If a manhole cannot be accessed or located, it is possible to obtain an acoustic score for 2 segments, but it is likely a lower score will occur due to sound energy dissipated in the intermediate manhole. Also, if the RX and TX unit are “close” to each other (within 50 feet or 15 meters), then it is recommended to obtain one measurement for the short segment, then another acoustic measurement with an intermediate manhole in between.

**Q29: What are the output results and how are they stored?**

A29: The results are available to the user at the time of testing and should be recorded on a map, work order, or inspection log. The device stores the most recent 199 measurements. Measurement data can be downloaded free of charge using the Sewer Line Diagnostic OrGanizer (SL-DOG®) PC client. This requires a Windows PC, internet connection and a USB port. The data format is a comma delimited text file (CSV) that can be opened in Excel. Included are data such as measurement ID, time stamp, assessment score and GPS coordinates. There is no charge for the PC client software or downloading the raw CSV file from the SL-RAT® device.

Once the data are downloaded from the device it can also be accessed using the SL-DOG® web portal service. The portal service includes additional features such as the ability to correct and modify GPS coordinates, re-scoring the acoustic assessment based on actual distances, and the ability to convert data into a format that can be used in mapping software (both KML file for Google Earth and SHP file for ArcGIS). The SL-DOG® web portal service is included with the device for the first year of operation, there is an additional charge for this optional service after the initial trial period.

**Q30: If I wanted to acquire an SL-RAT®, what are my options?**

A30: Devices can be purchased, rented, or leased. Purchased devices include a one year limited warranty and the option to subscribe to our SL-DOG® software package. In addition, there are many contractors that can perform acoustic inspections as a subcontracted service.