RMLD

Operating Instructions

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Please read and understand the following operating instructions before using the equipment; they will help you to use the instrument quickly and competently. If you have any queries we are available to offer advice and assistance at any time.

Yours

Hermann Sewerin GmbH
Robert-Bosch-Straße 3
33334 Gütersloh, Germany
Tel.: +49 5241 934-0
Fax: +49 5241 934-444
www.sewerin.com
info@sewerin.com

Sewerin USA, LLC
2835 Haddonfield Road
Pennsauken, JJ 08110-1108
Phone: +1 215-852-8355
Fax: +1 856-662-7070
www.sewerin.net
sewerin-usa@sewerin.net

SEWERIN SARL
17, rue Ampère - BP 211
67727 Hoerdt Cedex, France
Tél. : +33 3 88 68 15 15
Fax : +33 3 88 68 11 77
www.sewerin.fr
sewerin@sewerin.fr

Sewerin Ltd
Hertfordshire
UK
Phone: +44 1462-634363
www.sewerin.co.uk
info@sewerin.co.uk

SEWERIN IBERIA S.L.
Centro de Negocios Eisenhower
Avenida Sur del Aeropuerto
de Barajas 24, Ed. 5 Of. 2C
28042 Madrid, España
Tel.: +34 91 74807-57
Fax: +34 91 74807-58
www.sewerin.es
info@sewerin.es

Sewerin Sp.z o.o.
ul. Annopol 3
03-236 Warszawa, Polska
Tel.: +48 22 519 01 50
Fax: +48 22 519 01 51
Tel. kom.+48 501 879 444
+48 608 01 37 39
www.sewerin.com
info@sewerin.pl

Operating Instructions

RMLD

Remote Methane Leak Detector

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- This product may only be taken into operation after reading thoroughly the accompanying operating instructions.
- This product may only be used for intended applications.
- This product is destined for industrial and commercial applications.
- Repairs may only be performed by the manufacturer or appropriately trained staff.
- The manufacturer is not liable for damage resulting from arbitrary modifications of the product.
- Only spare parts may be used which are approved by Hermann Sewerin GmbH.

Technical changes within the scope of further development reserved.

Danger!
The visible green Spotter laser is a Class IIIa laser product. Do not look into the beam or view directly using optical instruments.

CAUTION!
Do not attempt to repair this device. Please refer to Section V in this manual if the device does not work correctly or indicates a fault or warning.

Warning!
Do not switch on or use the RMLD indoors if there is any indication, possibility or suspicion that an explosive level of gas may be present.

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Overview

The Methane Leak Detector (**RMLD™**) uses state-of-the-art technology to identify methane leaks from a considerable distance. The RMLD the first of a new generation of leak monitoring devices that significantly improve the productivity and safety of mobile monitoring activities.

Using the RMLD, it is now possible to monitor areas that are hard to reach or are not easy to access. The use of TDLAS (Tunable Diode Laser Absorption Spectroscopy) laser technology means that the RMLD does not need to be located directly in the gas plume. As the laser passes through a gas plume, the methane absorbs a portion of the light, which is then detected by the RMLD. This technology makes it possible to detect leaks along the line of sight without always having to walk the full length of the gas pipe.

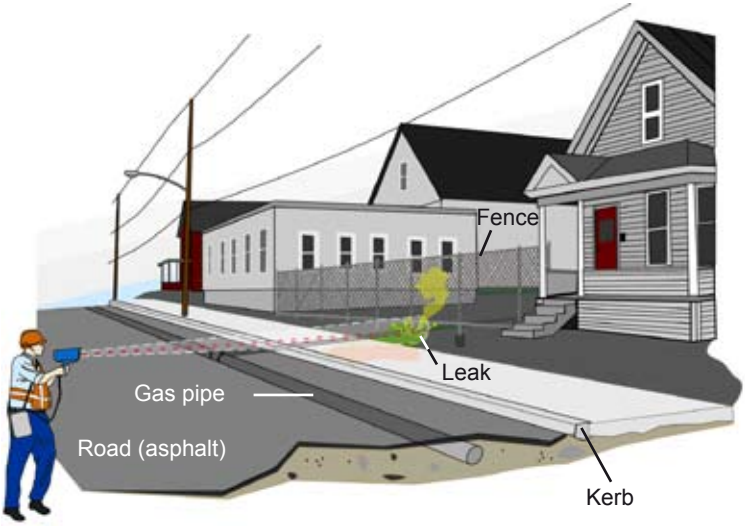

Figure 1-2

Remote detection using laser technology, allows areas to be safely monitored that may otherwise be difficult to reach, such as busy roads, properties with guard dogs, fenced off areas, and other hard to access places.

The device is designed to selectively detect methane only, and will not give a false alarm should other hydrocarbon gases be present. Gas concentration is calculated according to the amount of infrared light absorbed by the gas. Because the gas is detected along the line of sight of the laser, the concentration is given in ppm•m (parts-per-million•meter). In other words, the RMLD measures the concentration of the gas cloud multiplied by its width. Depending on the local meteorological conditions, a given amount of gas escaping from the ground will produce a plume that varies in size and uniformity of concentration levels. Gas plumes are variable in nature and depend on the soil conditions, temperature, wind, and leak rate.

The RMLD consists of two main components that interact with each other:

- Transceiver
- Controller

Figure 1-3: The RMLD system consists of a laser transmitter/receiver and a controller

The transceiver has two lasers. The infrared laser is invisible and is continuously active when the device is switched on. The visible green spotter laser must be activated by the operator by pressing the trigger button.

The RMLD can be operated in a wide variety of environmental conditions, including cold and hot weather and light rain. Its rugged design will withstand normal field use and operating conditions. Sensitivity and range are not negatively affected by normal amounts of dust on the optics window.

The RMLD includes integrated self-test and calibration functions that guarantee correct functioning of the device. The calibration cell built into the carrying case allows the operator to carry out the self-test and calibration as part of a daily start up routine. While in use, the RMLD continuously monitors several parameters to ensure that the instrument is functioning correctly. Should any of these parameters exceed the specified operating limits, an audible alarm will sound and a fault/warning error message will be shown on the display.

The device is supplied with a training video. It is strongly recommend that all operators view the video in order to learn the basic techniques required to carry out monitoring using the RMLD.

Section I (System description)

1.1 Technical data for the RMLD system

Detection method:	TDLAS (Tunable Diode Laser Absorption Spectroscopy)
Measurement range:	0 to 99,999 ppm•m
Sensitivity:	5 ppm•m at a distance of 0 to 15 m Min. 10 ppm•m at a distance of 15 to 30 m
Detection range:	30 m (nominal). Actual distances may vary depending on the type of background and other conditions.
Beam size:	Conical beam, width 56 cm at 30 m
Alarm modes for detection:	DMD (Digital Methane Detection) ● Audible signal, variable pitch according to concentration when the alarm activation threshold is exceeded. ● Alarm activation threshold adjustable from 0 to 255 ppm•m. Pure Tone ● Continuous audible signal, variable pitch according to concentration.
System fault warning:	Audible signal and symbol on display
Self-test and calibration:	Integrated self-test and calibration function for checking correct operation and adjusting laser wavelength for best sensitivity. Gas test cell integrated into carrying case
Standards complied with:	EMC (EN 61000-6-2, EN 6100-6-4) (pending)

Laser safety (eye protection):	CDRH, ANSI and IEC ● IR detection laser – Class I ● Green spotter laser – Class IIIa: Do not look into the beam or view directly using optical instruments.
Display:	Large, easy to read display with backlight (0.75 inch, numeric)
Operating temperature:	-17 °C to 50 °C
Humidity:	5 to 95% (non-condensing)
Housing:	IP54 (protected against water spray and dust)
Weight of device:	4 kg (transceiver 1.3 kg, controller 2.7 kg)
Carrying case:	6.4 kg; 86 cm x 24 cm x 36 cm
Power supply:	Internal lithium-ion rechargeable battery External backup battery pack holding 5 type “C” cells (optional)
Battery operating life:	8 hours at 0 °C with backlight switched off (internal battery)
Charger:	External universal charger 110–240 V/AC, 50/60 Hz with charge indicator (max. 8 hours for full charge)
Shoulder strap:	Single shoulder strap with pad Ergonomic dual shoulder strap harness with belt (optional)

1.2 RMLD system components

This section describes the features of the RMLD. Please refer to Figure 1-4 for illustrations of individual parts.

Figure 1-4: System components

1.2.1 Controller

The controller provides the user interface, menu selection keys, and external connections including: RS-232 port, battery charger port, external power supply port, headphone port, and power switch.

1.2.2 Transceiver

The transceiver houses the infrared detection laser and the visible green spotter laser, and has a trigger for the spotter laser. The unit also has hooks for the carrying strap.

1.2.3 Carrying strap

The RMLD comes complete with a single carrying strap, including shoulder pad. An optional dual shoulder strap harness is also available.

1.2.4 Charger

A battery charger is supplied with the device for recharging the battery. The charger is a universal charger, 110–240 V/AC, 50/60 Hz, and features a charge indicator. Adapters for different types of mains sockets are also supplied with the device.

1.2.5 Carrying case

The carrying case provides protection for the device during transportation and storage. The device must always be stored in this case when not in use. A gas calibration cell is integrated into the case.

1.2.6 Headphones

Allow audible signals to be heard through headphones instead of the external loudspeaker.

1.3 Optional accessories

1.3.1 Dual shoulder strap harness

The dual shoulder strap harness provides additional comfort and support when carrying the device for extended periods. The integral lanyard is used to carry the weight of the transceiver and provides additional stability and control over the unit during monitoring activities. SEWERIN recommends the use of this harness by all personnel who operate this equipment for extended periods, in order to limit fatigue when holding the transceiver and to improve monitoring technique.

1.3.2 External power source

The external power source is a back-up battery that allows the device operating time to be extended when the internal battery has insufficient charge. Power is supplied by 5 type “C” cells.

Section II (Battery charging)

2.1 Rechargeable battery

The RMLD is fitted with an internal lithium-ion battery that provides the main source of power for the device. This battery is designed to provide 8 hours of device operation when fully charged. The battery must be recharged every time the device is not in use in order to guarantee uninterrupted use of the device. A battery charge indicator is provided on the display. This indicator is accurate to within 20% of actual capacity. The indicator should only be used as a guideline value. Always start the day with a fully charged battery to ensure that the device can be used for the whole day.

In order to maintain the best possible accuracy for the charge indicator, the battery should regularly be discharged completely and then fully recharged without interruption. To deep-discharge the battery, allow the device to continue operating until it switches off automatically. This procedure may also be required if the charge indicator does not correspond to the actual charge e.g. if the battery stops operating despite the fact that the charge indicator is flashing or shows that the battery still holds a charge.

Figure 2-1

Note
To ensure the battery stores its full capacity, charge when the ambient temperature is above 10 ºC.

CAUTION!
To prevent damage to the battery or electrical circuits, always plug the charger into a surge-protected socket.

2.2 Charger

The RMLD is supplied with a universal AC battery charger. The plug on the charger can be changed according to the type of socket available.

2.3 Charging procedure

Carry out the following procedure to recharge the internal battery.

1. Switch off the device.
2. Insert the AC plug into a surge-protected socket.
3. Insert the charger jack into the charger port on the RMLD.
4. The green LED will flash to indicate that the device is being charged.
5. Allow the device to charge until the green LED indicator is continuously lit.
6. Unplug the charger.

Warning!
Only use the RMLD charger supplied by SEWERIN to recharge the device. Use of any other type of charger may cause severe damage to both the battery and electrical circuits.

Section III (Operating the RMLD)

The section provides information on operating the RMLD. This includes an explanation of how to use the menu, how to set operational parameters, and the procedures for activating various features of the device.

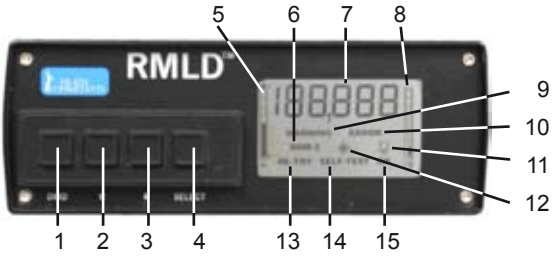

Figure 3-1 RMLD front panel with display.
(Note: The illustration shows all icons displayed simultaneously. During actual operation, only those symbols related to an active function will be displayed.)

1	**DMD key**	Press this key to activate/deactivate DMD mode
2	**Up key**	Press this key to increase a value or to acknowledge an on-screen prompt.
3	**Down key**	Press this key to decrease a value.
4	**SELECT key**	Press this key to scroll through the menu options.

Display

5	**Battery charge indicator**	Shows remaining charge in the battery.
6	**DMD symbol**	This symbol indicates when DMD detection mode is active.
7	**Gas concentration**	Shows the amount of gas detected in ppm•m. The display “1-------” indicates a value is out of range.

8	**Volume**	Shows the volume level for the loud speaker and headphones.
9	**WARNING symbol**	This symbol indicates that the device is operating outside functional limits.
10	**ERROR symbol**	This symbol indicates a fault i.e. the device is not functioning correctly.
11	**Backlight symbol**	This symbol indicates that the backlight is switched on.
12	**Spotter symbol**	This symbol indicates that the spotter laser is active.
13	**RE-TRY**	This symbol indicates that the self-test has not completed successfully and needs to be carried out again.
14	**SELF-TEST**	This symbol indicates that self-test mode is active.
15	**OK**	This symbol indicates that the self test completed successfully.

Figure 3-2: RMLD rear panel

HEADPHONE port	Socket for the headphone jack.
CHARGER port	Socket for the battery charger jack.
POWER SWitch	Pressing this switch turns the device on/off.
External power supply connector, **EXT. POWER**	Socket for the backup battery jack.
RS-232 port	Female sub-D connector for PC interface (only used for factory calibration).

3.1 Switching on the RMLD

Press the power switch located on the rear panel. When the device is switched on, the green spotter laser will flash briefly and the display will show all symbols together for a short period. The display will then switch to the main operating mode showing the ppm•m measurement value. The warning symbol will also be displayed briefly during the warm up period for the laser. This warning should disappear after a few seconds. The device will start up using the same settings that were active when it was switched off (e.g. alarm activation threshold, spotter active, etc.).

Note:
The infrared detection laser is always active and the device continuously monitors methane concentration whenever it is switched on.

3.2 Switching on the spotter laser

CAUTION!
The green spotter laser is controlled by the operator and is only switched on when the spotter trigger is pressed. When using the green spotter laser, never point the beam at another person's eyes and take care not to distract drivers of vehicles. This laser is of the same type used in commercially available laser pointers, as commonly used for presentations. This laser is safe provided it is used correctly.

Danger!
The visible green spotter laser is a Class IIIa laser product. Do not look into the beam or view directly using optical instruments.

Figure 3-3

3.3 Switching off the RMLD

Press the power switch located on the rear panel. The device will switch off. All settings will be saved automatically (e.g. alarm activation threshold, spotter active, etc.).

3.4 Using the menus

The RMLD allows the operator to set certain operational parameters and to activate/deactivate functions. The following operational parameters can be changed by the operator:

1. Volume
2. Alarm activation threshold

The following functions can be activated and deactivated:

1. Self-test
2. Spotter
3. Backlight

Pressing the menu key will scroll through the menu options in the following sequence:

Self-test

- Press the up key to start the self-test and calibration.
  - Press the up key to acknowledge on-screen prompts (OK or RE-TRY)

VOL

- Press the up key to increase the volume
- Press the down key to decrease the volume

SPO

- Press the up key to activate or deactivate the spotter laser

AL

- Press the up key to increase the alarm activation threshold
- Press the down key to decrease the alarm activation threshold

Figure 3-4

BACLI

- Press the up key to activate or deactivate the backlight for the display

Figure 3-5

The ppm•m measurement value will not be updated while menu options other than the main screen are displayed, however the device will continue to function normally.

3.5 Using DMD mode

DMD (Digital Methane Detection) mode is a highly sophisticated detection algorithm that greatly enhances the use of the RMLD. In most situations, the operator should carry out monitoring with DMD mode activated. Press the DMD key to activate DMD mode (the DMD symbol will be shown on the display). This mode can only be activated when the display is showing the main monitoring screen.

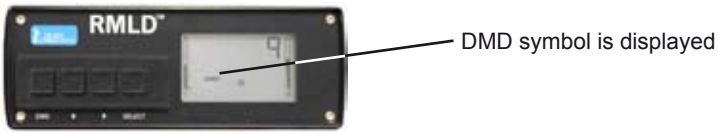

Figure 3-6: The DMD symbol is displayed while DMD mode is active.

When DMD mode is active, no sound is produced until methane is detected. The pitch of the sound is dependent on the concentration of methane. The higher the pitch, the higher the methane concentration.

A low-pitched pulsating or continuous sound indicates a warning of low infrared laser intensity or a problem with the device. A warning symbol is also displayed in cases where the light intensity is too low (see Section 4.2). The operator must move closer to the gas plume in order to be in detection range.

If the warning continues to be displayed, then this may indicate that there is a fault in the device. Check the error code and follow the instruction in Section V.

When in DMD mode, the device will indicate that methane has been detected when the ppm•m measurement value exceeds the average background level plus the alarm activation threshold, or when the reading is excessively high. Even when the low light intensity warning signal is audible, the RMLD may still be able to detect very high gas concentrations; this situation is indicated by a higher pitched sound.

The alarm activation threshold controls the sensitivity in DMD mode. The alarm activation threshold value can be adjusted by the operator. The monitoring procedures used by some organisations may require that a specific value is used or a that a certain adjustment procedure is followed. Set the alarm threshold value to a level that gives a low number of false alarms, while at the same time not being so high that gas leaks are not detected.

To change the alarm activation threshold, scroll through the menu options until the “AL” option is displayed. Press the up/down key to increase/decrease the threshold. Setting a higher threshold value will decrease the sensitivity of the device.

3.6 Using the Pure Tone mode

In “Pure Tone” mode, the RMLD will produce a continuous tone that is related to the instantaneous concentration level. The higher the pitch of the tone, the higher the methane concentration. If no sound is heard then this indicates low light intensity or a fault in the device. Note that the pitch will increase with increasing distance scanned. This is due to the background level of methane in the air.

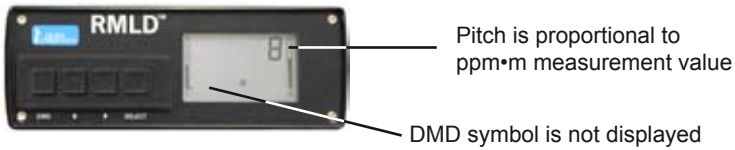

Figure 3-7

“Pure Tone” mode is most effective when used over short distances and can be helpful in detecting low concentrations or in identifying the location of the highest gas concentration.

Follow the procedure below to identify a leak producing a low concentration of gas:

1. Stand about 3 m from the leak, ideally upwind.
2. Sweep the laser back and forth across the leak, maintaining a constant distance.
3. Listen for a persistent increase in pitch as the beam passes through the leak. The pitch will only increase slightly if the leak is very small.

Follow the procedure below to identify the location of the highest concentration of gas:

1. Stand about 3 m from the leak, ideally upwind.
2. Sweep the laser in and around the area of the leak, starting from the upwind side.
3. Listen for the highest pitched tone.
4. Change the angle of the sweep slightly and rescan the area around the leak.
5. If the location that produces the highest pitched tone is consistent, then this indicates the location of the leak.
6. Continue scanning if the pitch of the tone produced is not the same. It is possible that the gas plume may be drifting around, which will produce inconsistent readings. In some cases, the gas plume may be so large that precise pin pointing of the source is not possible.

3.7 Self-test and calibration

The RMLD features an integrated function for carrying out a self-test and calibrating the laser wavelength. The self-test function should be run on a daily basis to ensure trouble-free operation of the device. Each self-test and each calibration should be recorded in a daily log. An example of a daily log can be found at the end of this manual.

Proceed as described below to carry out the self-test and calibration.

1. Remove the controller from the carrying case.
2. Switch on the device and allow to warm up for 2 to 3 minutes.
3. Place the transceiver in the carrying case in the position designed for this purpose, ensuring that it is level and properly seated.
4. Press the SELECT key until the SELF-TEST symbol appears on the display. (Note: The RE-TRY and OK symbols will also be displayed).

Figure 3-7

5. Press the up key to start the test. The number 255 will be displayed.
6. The OK symbol will be displayed if the device completes the self-test satisfactorily.
   – If the RE-TRY symbol is displayed, then the self-test was not completed successfully. Press the up key to restart the self-test, referring to the instructions in the following section, “Calibration override”.
7. Press the up key This will initiate the procedure for calibrating the laser wavelength. The procedure takes about 45 seconds to complete, during which time the measured gas concentration value can be seen to vary up and down.
8. The OK symbol will be displayed when the device has successfully completed calibration of the laser.
   – The RE-TRY symbol will be displayed if the device is unable to successfully calibrate the laser. Press the up key to restart the self test.
9. Press the up key to acknowledge.
10. Press the SELECT key to scroll back through the display modes until the main screen is seen.

What if the device failed to successfully complete the self-test or calibration?

This is usually caused either by the transceiver being positioned incorrectly in the carrying case or by a drift in the laser wavelength. Ensure that the device is in the correct position, level and properly seated. Observe the gas concentration. This is usually around 1100 ppm•m, however values between 500 and 2000 ppm•m are acceptable. Restart the self-test and calibration after the above points have been checked.

3.7.1 Calibration override

Proceed as described below if the device calibration fails at Step 6 due to low initial measurement values.

1. Ensure that the device is still in the self-test menu (see Step 6 above).
2. Override the normal self-test function by pressing the DMD key. This will cause the laser calibration procedure to be carried out.
3. “OK” will be displayed at the end of the first sweep. Press the up key again to restart the sweep.
4. “Self-Test OK” will be displayed at the end of this sweep. Press the up key followed by the SELECT key to leave the self-test menu.
   – “RE-TRY” will be displayed if the procedure fails. This means that the device will not function correctly. Please contact SEWERIN directly for assistance.

Note:
Laser wavelength drift is a normal characteristic of the RMLD. Normally, the magnitude of the drift is small and does not have any negative effect on the self-test, provided this is carried out regularly. Monitoring work that is carried out using an uncalibrated device may have to be repeated. Please contact SEWERIN service if the initial measured concentration values are regularly so low that the calibration override feature must be used repeatedly.

The following table may help identify the cause of the problem if the self-test fails:

Cause	Corrective action
Low signal strength or noise	● Make sure that the battery is fully charged. ● Ensure that the device is in the correct position, level and properly seated.
Initial ppm•m measurement value too low or too high	● Make sure that the battery is fully charged. ● Ensure that the device is in the correct position, level and properly seated. ● Check the calibration cell for signs of damage. ● Use the calibration override function.
Laser adjustment failed	● Make sure that the battery is fully charged. ● Ensure that the device is in the correct position, level and properly seated. ● Check the calibration cell for signs of damage.

CAUTION!
If the device does not successfully complete a self-test after several attempts, do not use the device for monitoring work before the problem has been rectified. Please contact SEWERIN directly for assistance.

Section IV (Monitoring with the RMLD)

4.1 Monitoring with the RMLD

The RMLD is supplied with a training video, which is the best way to get an overview of the techniques used. It is important to learn these techniques in order to be able to effectively detect and monitor methane gas leaks. The purpose of the video is to familiarise personnel responsible for monitoring gas leaks with how to use the RMLD. The video does not provide any training in basic leak monitoring techniques.Please refer to your organisation's own training and procedural requirements for the specific qualifications necessary for leak monitoring.

Three **conditions** must be met before the RMLD is able to detect a gas leak:

1. The size and concentration of the gas plume must be greater than the minimum permitted by the sensitivity of the device.
2. The infrared beam must pass through the gas plume.
3. The target background (i.e. ground, building, etc.) must reflect the infrared beam.

The concentration and size of the gas plume are influenced by various factors. Leaks where a low volume of gas is escaping will only produce small or undetectable gas plumes. Additionally, some types of surface (e.g. concrete) spread the gas through cracks and holes in the surface, thereby creating leaks at several points. Weather conditions such as strong wind and high temperatures result in the gas plume being dispersed more quickly.The operator must take these factors and their corresponding effects into account whilst carrying out monitoring.

The most important factors when using the RMLD are correctly aiming and controlling the infrared beam.
The first things to learn in order to effectively use the RMLD for monitoring are to gain control over the direction of the laser and to use the correct speed of sweep. Sudden or jerky motions may lead to false detections due to rapid changes in distance or changes in the background reflecting the laser. This type of rapid motion can result in the area not being thoroughly scanned by the laser.

Below are some tips for **patrolling the gas pipe on foot**:

- Use a smooth sweeping motion.
- Maintain a target distance for the beam of 5 to 7 m. This means that the footprint of the beam on the ground is large enough to provide good coverage, while still giving good control over the path of the beam.
- Scan the areas around connections and valves as you approach them.
- Direct the beam at likely leak locations (e.g. cracks, damaged vegetation, etc.).

Consider the following points when scanning a gas pipe or gas meter in familiar locations:

- Make full use of the advantages of the beam by sweeping more widely around the pipe.
- Trace out an “S” pattern with the beam while moving along the pipe.
- Scan the area around the gas meter.
- Rescan the pipe in the opposite direction, again following an “S” pattern.
- Move closer to the pipe if the area to be scanned is too far away or raised ground means that the beam does not hit the surface (dark zones).

Proceed as follows when scanning a **gas pipe at an unfamiliar location**:

- Use an “X” pattern or similar to ensure that the area is thoroughly scanned.
- Target areas where gas typically escapes e.g. along streets and pavements.
- Target areas where valves might be located.
- Scan along the foundations of buildings.
- Move closer to the pipe if the area to be scanned is too far away or raised ground means that the beam does not hit the surface, thereby causing dark zones (shadows).

Proceed as follows when scanning a **gas meter**:

- Maintain a distance of at least 3 m from the gas meter to ensure that the beam width is not too narrow.
- Thoroughly scan the ground in the area around the meter.
- Aim the device at the gas meter from the angle that provides the best background behind the meter.
- If the meter is in the open, or a limited choice of angles means there is no background available directly behind the meter, scan the meter using a horizontal “Z” pattern, making sure to maintain a constant sweep distance.

If a leak is found **near or on a gas meter**, the following tips will be of assistance in determining whether the leak is underground or on the meter.

- Stand upwind whenever possible.
- Stand about 1.5 to 3 m from the leak.
- Use the “Pure Tone” mode to pin point the highest concentration.
- Start by pointing the beam downwards towards the ground.
- Scan by moving the beam upwards and around the pipe. (Note: the spotter laser beam is approximately 7 cm higher than the infrared beam).
- In the case of underground leaks or if in doubt, clear the area around the leak if.

4.2 Long range scanning

The RMLD can detect leaks at a distance of up to 30 m. The actual maximum distance may depend on the characteristics of the target surface and variations in environmental conditions. As the scanning distance is increased, the intensity of the reflected laser light will become lower. An audible signal indicating low light intensity will be heard when the maximum scanning distance is reached. In such cases it will be necessary to move closer to the target.

For best results when scanning at distances greater than 15 m, it is important to slow down the scanning speed and to take extra care when aiming the laser. Make use of the spotter laser or the sighting marks on the side of the transceiver to ensure that the target area is scanned properly.

Be aware of any raised ground. Scanning across the peak of a mound or the corner of a building can cause the beam to skip (a sudden change in distance), which may lead to false measurements.

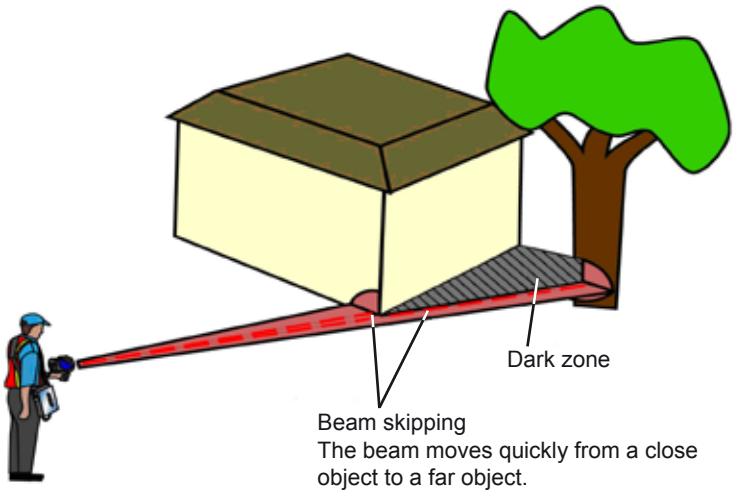

Figure 4-1: Sudden changes in distance may lead to false measurements

Obstructions or changes in the landscape can create dark zones where it is not possible to scan with the laser. Look for the best angle from which to aim the laser in order to scan these areas thoroughly. Scanning upwards along a slope may lead to beam skipping or dark zones around the foundations of a structure.

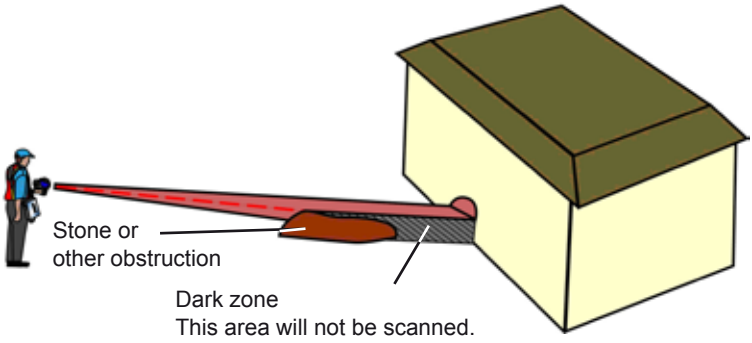

Figure 4-2: Raised ground or obstructions in the line of sight create dark zones (shadows).

4.3 Dealing with false detections

There are several conditions that may occur when using DMD mode that can lead to the algorithm giving a false detection indication. In most cases these are caused by one of the following situations:

- Sudden or jerky motions that lead to a sudden change in scanning distance.
- Excessively high measurement values due to strong reflectors.

The majority of false detections occur when scanning at a in the **15-m-range**. This is due to the beam footprint becoming very large. In DMD mode, abrupt motions, changes in terrain or changes in distance to a target object may cause the device to indicate briefly that a low gas concentration has been detected. In order to ensure that the detection is due to an actual gas leak, the same area in the 15-m-range should be scanned a second time.

Moving from long range to short range whilst scanning will also help minimise false detections.

Strong reflections from certain surfaces (e.g. black rubbish bags, water droplets, glass, polished surfaces, stones, vehicle number plates, reflectors, etc.) can also lead to false detections. Rescan the area from a slightly different angle.

4.4 How does the RMLD measure gas concentrations?

The RMLD can be used to monitor areas that are hard to access. The use of TDLAS (Tunable Diode Laser Absorption Spectroscopy) laser technology means that the RMLD does not need to be located directly in the gas plume. As the laser passes through a gas plume, the methane absorbs a portion of the light, which is then detected by the RMLD. This technology makes it possible to detect leaks along the sight line without always having to walk the full length of the gas pipe.

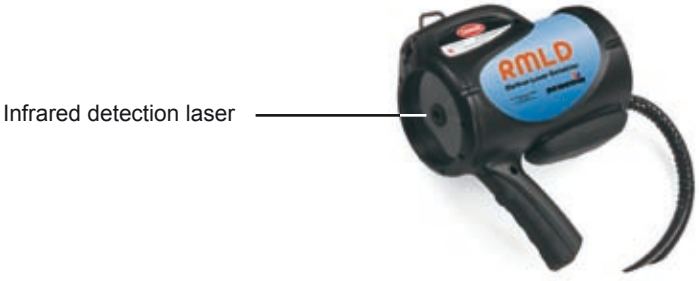

Figure 4-3

The invisible infrared detector laser beam is emitted through the emission aperture. With a normal background, e.g. brick, concrete or grass, this has a maximum range of up to 30 m (actual distance may vary depending on the characteristics of the surface).

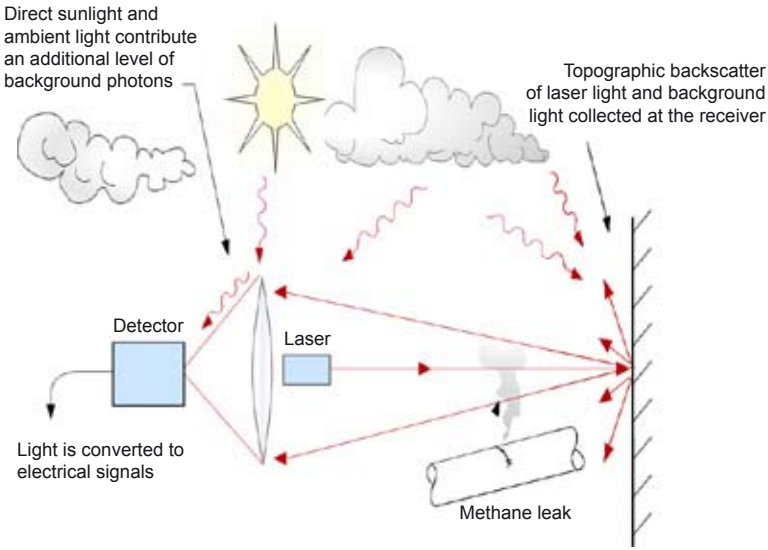

Figure 4-4

The diagram above shows how the device uses reflected light to detect leaks. After passing through a gas plume, the infrared laser beam is reflected and received at the detector, where it is collected and converted to an electrical signal that transmits the information needed to determine the methane concentration.

The laser is designed to selectively detect methane and will not give a false alarm should other hydrocarbon gases be present.

The signal is processed to allow methane concentrations to be reported in ppm•m (parts-per-million•meter).

The ppm•m value is the product of methane concentration multiplied by gas plume width. For example, if a leak generates a gas cloud of 1000 ppm that is approximately 0.5 m wide (the distance travelled by the infrared beam through the plume), then the RMLD will measure a value of 500 ppm•m.

By way of another example, consider a medium-concentration gas cloud of 20 ppm that is approximately 2 m wide; the RMLD will measure a value of 40 ppm•m plus, in this case, a background level of 15 ppm•m, meaning that a total value of 55 ppm•m is displayed.

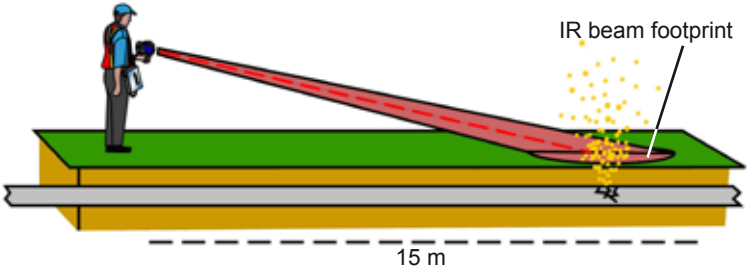

Figure 4-5: The ppm•m measurement value is the product of gas plume concentration multiplied by the distance that the beam passes through the gas (width of the gas plume) plus any background gas concentration level. The footprint of the laser beam increases with the scanning distance.

Example

Scanning distance	= 15 m
IR beam footprint	= 4.9 m x 0.3 m
Background methane level	= 1 ppm
Average gas plume concentration	= 20 ppm
Width of the gas plume (distance that the IR beam travels through the plume)	= 2 m
RMLD measurement value	= background level + leak concentration = (15 m x 1 ppm) + (2 m x 20 ppm) = 55 ppm•m

At a distance of 30 m, the width of the infrared beam is approximately 55 cm. It is important to note that the length and width of the laser footprint increase as the distance to the target increases (see Figure 4-5). For this reason, it is considerably easier to detect leaks from a distance of 5 m of more.

Note:
Atmospheric air always contains a low level of methane. This natural background methane level is also measured by the RMLD. The ppm•m measurement value therefore increases as the scanning distance is increased.

Note:
The nature of gas plumes varies considerably. The illustrations above are only intended to give an illustrate the basic theory. With some leaks it is possible that there is a high surface methane concentration, with little or no detectable gas plume above the ground.

Section V (Maintenance and troubleshooting)

5.1 Troubleshooting the device

The advanced design of the RMLD makes it one of the most reliable leak monitoring devices available today. However, should problems occur with the device, or if it is suspected that the device is not functioning correctly, then it should not be used for monitoring until the problem is rectified.

Repairs and adjustments to the device must only be carried out by qualified RMLD repair technicians. The RMLD does not contain any components that can be repaired or replaced by the user.

In most cases there is a simple explanation for problems with the device. The following table contains a list of the most common faults, causes and solutions. Pleased contact SEWERIN for further assistance if a fault is encountered that is not listed here, or the suggested solution does not rectify the problem.

Symptom	Possible cause(s)	Solution
Higher measurement values than usual are obtained when measuring at short range and measurement values are lower than usual at longer range.	● Laser calibration drift	● Run self-test
Measurement value for the gas concentration is low and self-test did not complete successfully	● Laser calibration drift	● Run the self-test and use the override function

Symptom	Possible cause(s)	Solution
The override function has to be used every time the self-test is run	● Laser calibration drift ● Laser calibration drift is too high	● Run self-test daily ● Contact SEWERIN
The device will not switch on	● Battery not charged	● Charge the internal battery or ● use the external power source
An audible warning signal is repeatedly heard during scanning/a warning symbol is displayed	● Scanning is being carried out beyond the range of the RMLD ● The background surface is absorbing or reflecting the light ● Battery not charged	● Move closer to the target or ● Change the angle of the laser to the target to take advantage of a better reflecting background ● Check the charge level of the battery and recharge if required
An excessive number of false detections occur when scanning at long range	● Scanning is being carried out to quickly ● Alarm threshold value is set too low ● Scanning is being carried out beyond the range of the device	● Scan more slowly. Pause at long range and sweep the beam closer ● Increase alarm activation threshold ● Move closer to the target

Symptom	Possible cause(s)	Solution
An excessive number of false detections occur when scanning at short range	● Scanning is being carried out to quickly ● Alarm threshold value is set too low	● Avoid sudden movements whilst scanning ● Increase alarm activation threshold
An excessive number of false detections occur or a loss in sensitivity is experienced	● Laser output not optimised ● The alarm activation threshold is set too high or to low for the prevailing conditions.	● Run self-test ● Check alarm activation threshold
Error symbol or warning symbol shown permanently	● Battery not charged ● Condensation on the mirror due to rapid temperature change ● Failure of an internal component	● Check the charge level of the battery and recharge if required ● Wait until the temperature has stabilised ● Make a note of the error code and contact SEWERIN
Battery indicator shows that the battery is not fully charged after charging	● Battery not fully charged ● Battery charge indicator calibration error	● Charge the battery until the green LED on the charger is permanently lit ● Run the device until it switches off automatically, then charge the battery fully without interruption

Symptom	Possible cause(s)	Solution
Bars on the battery indicator are flashing	● Battery charge indicator calibration error	● Run the device until is switches off automatically, then charge the battery fully without interruption

5.2 Maintenance

In order to maintain the RMLD in proper working order, the following maintenance tasks must be carried out at the specified intervals.

Maintenance task	Interval
Clean outer surfaces with a damp cloth	As required
Clean the transceiver window with a non-abrasive lens cloth	As required to remove built-up dust or water marks
Self-test and calibration	Daily to ensure that the device continues to function correctly
Charging internal battery	Recharge fully after every use

Glossary

Beam skipping	This term refers to the effect that occurs when the distance to the target for the IR beam suddenly changes. This may lead to a false detection.
Controller	The part of the RMLD carried on the body that includes the keypad and display
Dark zone	An area that is not scanned because it lies behind an obstruction. This can be caused, for example, by raised ground, the side of a building, the area behind a kerb, etc.
DMD mode	Digital Methane Detection An advance detection mode that, when activated, means the operator is only alerted when there is a good probability that methane gas has been detected.
Footprint	The surface area covered by the IR beam. This increases with distance. At a range of 30 m, this area has a diameter of approximately 55 cm when the beam is aimed horizontally at vertical target.
Infrared (IR)	A wavelength of light just beyond the visible spectrum.
Laser calibration drift	A normal characteristic of tunable laser diodes that means the calibrated wavelength can gradually change over time. The RMLD includes an integrated self-test and calibration function that automatically maintains correct calibration.
ppm•m	The product of methane concentration multiplied by gas plume width
Pure Tone mode	An operating mode that causes a continuous tone to be produced, the pitch of which is relative to the gas concentration.

Spotter laser	The green flashing laser located at the top of the transceiver, used by the operator to indicate the direction of the IR beam. This laser is activated using the trigger button on the handle of the transceiver.
TDLAS	Tunable Diode Laser Absorption Spectroscopy A method of detecting gas that makes use of a laser. The laser light is partially absorbed when shone through a cloud of methane, thereby allowing the gas concentration to be measured.
Transceiver	The hand-held part of the RMLD that contains the invisible IR laser transmitter/receiver and the green spotter laser

Daily log of RMLD self-test and calibration

RMLD serial no.: .....

Date	Operator	Self test successful?	Self test ppm•m measurement value	Alarm activation threshold	Notes

Hermann Sewerin GmbH
Robert-Bosch-Straße 3 · 33334 Gütersloh · Germany
Telefon +49 5241 934-0 · Telefax +49 5241 934-444
www.sewerin.com · info@sewerin.com

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