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OPERATOR'S MANUAL

  
**Marksman™ II**  
*Ultrasonic Diagnostic Tool*

What You Can't Hear Is What  
You Need To Hear!



**TRACER PRODUCTS**

A Division of Spectronics Corporation

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## DECLARATION OF CONFORMITY

This is to certify that this equipment, designed and supplied by Tracer Products, a division of Spectronics Corporation, 956 Brush Hollow Road, Westbury, New York, 11590, U.S.A., meets the essential safety requirements of the European Union and is placed on the market accordingly. It has been constructed in accordance with good engineering practice in safety matters in force in the Community and does not endanger the safety of persons, domestic animals or property when properly installed and maintained and used in applications for which it was made.

Equipment Description ..... Marksman II Ultrasonic Diagnostic Tool  
Applicable Directives ..... 73/23/EEC as amended by 93/68/EEC  
2004/108/EC  
2002/95/EC (RoHS)  
Applicable Standards ..... EN 61010-1: 2001  
EN61326-2: 2006  
EMC CI A, Immunity Criteria B  
CE Implementation Date ... January 15, 2001

Any questions relative to this declaration or to the safety of Spectronics Corporation's products should be directed, in writing, to our Customer Service Department at the above address.

 **WARNING**

**This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the instrument.**

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## FEATURES

The Marksman II Ultrasonic Diagnostic Tool converts and amplifies inaudible ultrasonic sound into audible “natural” sound by employing technologically advanced circuitry. It operates on the principle of detecting high frequency ultrasonic waves, which are created by friction from all moving parts, whether solid, liquid or gaseous. These “sounds” reside far above the range of the human ear and tend to be highly directional.

This directional aspect of ultrasonic waves allows one to isolate a suspect signature sound from other background noises and detect its exact location. This sound analysis can be used for efficiently investigating the following areas of repair and preventive maintenance in the following transportation and industrial applications:

1) **Air leaks**

Both vacuum and compressed air leaks create an energy packet or wave front which can result in an ultrasonic emission with a differential of 5 psi from a 12 inch (30.5 cm) distance, and/or a hole down to 0.004 inches (0.1 mm) in diameter.

2) **A/C refrigerant leaks** (for most types of refrigerant)

3) **Gas and liquid turbulence**

Turbulence associated with steam trap and internal valve leaks, cavitation, and blockages in liquid and air/gas lines.

4) **Electrical discharge**

Electrical discharge associated with insulation breakdown, tracking, corona and arcing.

5) **Diagnosing solenoid operations**

6) **Mechanical wear**

State of mechanical wear in bearing and race assemblies, shafts and gears (also indicating the state of lubrication).

## INTRODUCTION

Faults, malfunctions and/or flaws in mechanical, electrical and pneumatic devices, as well as in container-type objects, start as small defects or leaks. The physical size of these defects is so relatively small that the sounds they produce are above the range of human hearing. Most commonly, these faults generate sounds in the 38,000 to 43,000 cycles per second range, generally referred to as being in the ultrasonic range.

To employ the ultrasound methodology in a usable manner, it is imperative that the listener have access to an audible sound that bears a resemblance to the natural sound of the defect. A mechanical bearing with a defective ball should sound like such. **Likewise, converting the ultrasound frequencies to audible frequencies is not sufficient with regard to rendering a usable signal. For this reason, the Marksman II incorporates a process whereby the audible signal bears a close likeness to the natural incoming sample.** We call this process “Sound Signature Technology,” whereby a gas leak sounds like a gas leak and a defective bearing sounds like one.

## GENERAL INFORMATION

The Marksman II is sensitive only to ultrasound (40.5 kHz) and is unaffected by audible noise. Internal Noise Control (I.N.C.) allows the use of this instrument in extremely noisy environments such as mechanical rooms, around operational chillers, etc. Drag your finger upwards on the sensitivity touch pad to increase sensitivity when experiencing little or no environmental noise. Drag your finger downwards on the sensitivity touch pad to reduce sensitivity in response to an increase in environmental noise. The I.N.C. works much like a two-way radio squelch allowing only the strongest and closest signals to penetrate the electronic wall built by the I.N.C. circuitry.

Many variables can affect the amount of ultrasound generated by the leakage of gas through an orifice. Such factors include the pressure/vacuum versus the surrounding environment, how smooth the edges of the orifice are, the diameter of the orifice, the leak detector's distance from the orifice and the presence of airflow, which may dissipate the ultrasound. As you use the Marksman II, keep in mind that these factors may affect your ability to detect ultrasonic leaks.

## **KIT CONFIGURATIONS AND COMPONENTS**

### **TP-9367 Master Kit Contains**

1. The Marksman II ultrasonic receiver. This easy-to-use unit incorporates audio feedback and five LEDs to indicate the intensity of the signal. The receiver has a permanently fixed 2-inch directional receiver port, 3.5 mm stereo jack port, sensitivity adjustment pad and power button.
2. One black rubber  $7\frac{3}{8}$  inch (18.7 cm) air probe, and a precision-length contact probe.
3. A full-sized headphone set with a 3.5 mm stereo jack.
4. A rugged carrying case for storage and transportation.
5. The ultrasonic emitter. Sends out a 40kHz pulse for use in testing seal integrity in non-pressurized vessels.
6. Two "D" cell alkaline batteries.

### **Ultrasonic Emitter**

The emitter gives off a warble output centered at 40kHz. This output cannot be heard by the human ear. If the red indicator is on, the unit is emitting.

## **Air and Contact Probes**

The air and contact probes are precision parts, designed to optimize the response of the Marksman II receiver. The 12 inch air probe extends its reach and can isolate one leak among multiple suspect areas. Do not modify the probes in any way and never use the probes for applications other than described in this manual.

## **BATTERIES (CHANGING/REPLACING/DISPOSAL)**

*Two "D" cell alkaline batteries are required (included).* When the batteries near the end of their useful life, the battery LED will flash. To change the batteries, depress the release tab using a coin or a screwdriver and slide back the cover. Replace the batteries with two new "D" cell alkaline batteries. Replace the cover by holding it in place along the side rails while sliding it forward to engage both the rear hooks and the front release tab.

Be sure to dispose of batteries in a manner dictated by your local laws.

## **IMPORTANT TIPS**

### **Receiver and Emitter Port Openings**

The port openings of the receiver and emitter contain a precision transducer, the heart of the Marksman II's operation. *During use, guard against any foreign matter entering this area.*

### **Calibration**

The Marksman II has been optimally tuned at our factory and should require no recalibration during its life under normal conditions.

### **LED Display**

The LED display allows you to zero in on a steady-state source of ultrasonic sound, such as when locating an air or vacuum leak or when using the emitter. Simply watch for a rise or drop in the LEDs to pinpoint the source of the problem.

## Miscellaneous

To prolong battery life, turn off the Marksman II when not in use, avoid rough handling, and keep it away from the elements. Use the carrying case for protection and for transporting.

## SAFETY PRECAUTIONS

**While the Marksman II allows you to focus on diagnosing a problem in a fast and effective manner, never lose focus of your surroundings.**

1. Always remember that the Marksman II and its probes are an extension of your hand. Keep the probes and your hands a safe distance from moving parts and electrical areas.
2. Never overreach or destabilize your footing while using the Marksman II.
3. Stand a proper distance away from electrical and moving parts.
4. Always be aware of the headphone cord when near moving parts.
5. Wearing headphones hinders your ability to listen to your surroundings. ***Always be alert!***
6. Never use the contact probe to diagnose electrical problems.

## OPERATING INSTRUCTIONS

1. If you want to enable heterodyne mode (see page 10), plug the headphone jack into the receptacle located on the face of the panel.
2. If you need to isolate an ultrasonic source more precisely, attach the air probe into the receiver port. Or, the unit can be used without the air probe attached first.



3. Press the power button to turn the unit on. The Marksman II will turn on at maximum sensitivity. The instrument will not beep or tick in an idle state but the battery LED will illuminate to indicate that the detector has adequate power. When the battery LED flashes, this indicates that the batteries are nearing the end of their useful life and will soon need to be replaced.

**Please note:** Increasing the volume does not increase the unit's detection sensitivity. Setting the volume control too high can lead to operator fatigue.

4. Point the Marksman II in the direction of the suspected leak or defect and scan the area by making a slow "X" (a vertical and horizontal type sweeping motion) while keeping the probe pointed in the general direction of the suspected leak or defect.
5. The Marksman II will beep when it detects an ultrasonic disturbance. (When the headphones are plugged in, the unit will not beep. See Heterodyne Feature on page 10.) To isolate the ultrasonic disturbance, gradually decrease sensitivity by slowly dragging your finger down the touch pad until the beeping stops. The sensitivity level will be indicated briefly by the number of illuminated LEDs next to the touch pad.
6. Move closer to the suspected leak or defect, continuing the sweeping pattern and narrowing the range of the sweep by smaller patterns until the ticking once again increases. This will lead to the location of the ultrasonic disturbance. If an exact location is desired, attach the flexible rubber extension to the probe and repeat step 5.
7. Repair all leaks or defects as located and repeat the scan.

## **HETERODYNE FEATURE**

The Marksman II features heterodyne capability, which converts the ultrasonic frequencies detected by the instrument to sounds that can be heard by the human ear. This allows you to more easily isolate the ultrasonic source.

Simply plug the included headphones into the jack on the right side of the Marksman II to enable heterodyne capability. Dragging your finger upwards/downwards on the sensitivity touch pad will increase/decrease the volume of the headphones.

## **ULTRASONIC EMITTER**

The ultrasonic emitter is used with the Marksman II to locate leaks in walk-in coolers/freezers, wall and ceiling joints, around doors, windows, body seals, rubber moldings, ducts, etc. The emitter produces the precise frequency detected by the Marksman II. By placing the emitter in a sealed area and scanning the exterior of this area, any signal escaping from the sealed area will be indicated by the Marksman II. A flaw in the seal can quickly and accurately be pinpointed.

1. Turn on the emitter's power switch. The LED will illuminate to indicate it is operating.
2. Place the emitter into the area to be tested. Seal the area to be tested completely.
3. Set the "Sensitivity" control of the Marksman II to maximum.
4. Scan the exterior area for the suspect leaks.
5. To pinpoint leaks, see General Information on pages 5-6.
6. When using the emitter with headphones plugged into the Marksman II, the instrument will indicate ultrasonic disturbances through a variable-pitch tone.

## **HIGH NOISE ENVIRONMENTS**

In noisy environments, it may be necessary to “tune out” unwanted signals from other areas close to where you are scanning for leaks or defects. Begin by attaching the air probe extension over the nose piece. When the extension is attached, the sensing angle of the instrument is reduced, increasing the directional capability and reducing the effects of the adjacent noise sources. This allows the probe to become more directional.

If you suspect that your reading originates from a source other than what you are scanning, point the probe toward the other suspected source (it may be a compressor V-belt, discharging steam line, etc.) and slowly decrease the sensitivity until the alarm stops. Turn the probe back toward direction of the suspected leak or defect and continue to scan. This step may have to be repeated as you move around to other locations in search of leaks or defects.

If the probe is close to the internal moving parts of the equipment and the alarm sounds, push the rubber probe against the housing of the equipment. If the alarm still sounds, internal friction of moving parts, not a leak source, may be causing the alarm.

## **TYPICAL SCANNING METHODS/TIPS**

The Marksman II provides information in two ways: qualitative, through the ability to “hear” the signature ultrasounds produced by various types of equipment, and the ability to see the feedback level on multiple LEDs.

The air and contact probes are used to optimize the response depending on the type of inspection being performed. The air probe is best used for detecting ultrasounds associated with a pressure leak or an electrical corona, while the contact probe is best used to detect the ultrasounds generated from within a casing such as in a gear, bearing, pump, valve or steam trap housing.

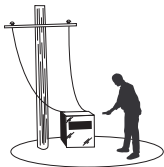
## Mechanical Malfunctions

The photo to the right shows a typical way to inspect a potential wheel bearing problem. In this case, the air probe is used since the wheel is being turned while listening for the sound of the bearings. The tip of the probe is kept 2-3 inches from the inspection area. Response can sometimes be optimized by removing the wheel and using the contact probe to touch the stationary center hub. This applies to motor housings as well when checking motor bearings. The contact probe is also used in the same manner for investigating fuel injectors and coil-over-shock suspension systems. Touch the tip of the metal probe to the surface area being tested. Correct operation sounds one way, while malfunction sounds another way. You will easily hear the difference.



## Electrical Corona Discharge

At right is a typical application using the Marksman II to detect possible electrical malfunctions by listening to the electrical corona discharge associated with power switches and breaker boxes. ***As with all potentially dangerous situations, use caution. Use the hollow air probe or use the receiver alone when inspecting electrical conditions and always keep a safe distance between the air probe tip and the metal panel surfaces.*** The Marksman II is highly sensitive to picking up voltage breakdowns. The resultant ultrasonic sound has been described as sounding like “frying bacon.”



## Pressurized and Vacuum Leaks

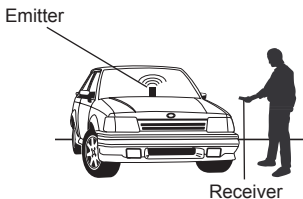
Applications for pressurized type inspections are endless, including compressed air or gas of any kind, air brake systems, pipes/pipelines, steam systems, water lines, manifolds, and likewise all vacuum systems. **Note:** Ultrasonic detection relies on detecting the sounds associated with the turbulence of the fluid or

gas exiting a hole or orifice under a differential pressure. It is independent of the type of gas or fluid in the system. The Marksman II will readily detect air and vacuum leaks typically caused by bad gaskets, worn valve seats and cracks in pipes, hoses or fittings.

### Non-Pressurized Leaks

Non-pressurized vessels or containers cannot generate ultrasonic sounds. The supplied ultrasonic emitter is used to broadcast an ultrasonic noise, which is optimized to the frequency response of the Marksman II receiver. Some examples are leaks in heating and cooling system ducts and pipes, tanks, windshields, weather-stripping and whole house integrity.

1. Turn on the emitter and place it in the enclosed environment to be evaluated. The emitter will fill the interior with a piercing warble sound. **Note:** Since the output is in the ultrasonic range, you will not hear it without the receiver.
2. Walk around the exterior of the enclosed environment while sweeping the receiver around the suspect areas. Compromised areas will be revealed by a change in tone and intensity, both audibly and visually, by listening and watching the changes on the LED display.



### Using the LED Display to Locate Leaks

Please note that the volume control is independent of the LED display during an inspection. Depending on the amount of ultrasonic signature being detected, you can use both the level of intensity on the LED display and the audible amount of sound through the headphones. As you get closer to the leak or defect, decrease the volume. As the sound gets louder, repeat the process until you have pinpointed the location.

## VEHICLE APPLICATIONS

**VACUUM LEAKS:** Place the hollow air probe on the unit and listen and watch the LEDs. You can pinpoint the location of vacuum leaks quickly and easily. **Use the hollow air probe or use the receiver alone.**

**FIND THAT ENGINE NOISE.** The Marksman II will locate those engine noises and let you find where they are truly coming from. Ultrasound does not transfer within engine components due to the directional characteristics of ultrasound. **Use the solid contact probe.**

**ELECTRICAL SYSTEMS:** Separations in high-tension spark plug wire conductors can be quickly identified from the corona discharge “snapping” sound emitted. The same applies to arcing within electrical motors and accessories. Also, listen to connection points for the “snapping” or “frying bacon” sound; this is a sound a poor connection makes under **electrical load**. Circuits are best tested under operation and full load.

The MarksmanII is also great at locating short circuits. Shorts give off a “frying” or “snapping” sound also. As you are checking for shorts or connection problems, do not forget to wiggle the wiring! Those electrical problems will now call out to you. Save time! **Use the hollow air probe or use the receiver alone.**

**IGNITION SYSTEMS:** Listen to today’s ignition systems. You can hear the coils and plugs firing. This is by far the best and quickest method for diagnosing Coil Over Plug (COP) systems. It also works great on Distributorless Ignition Systems (DIS). You will hear the snapping of the plugs firing in the headset. After some experience testing ignition systems, you will be able to tell if you have a plug or wire problem by the sound alone. When checking DIS systems, make sure you listen at both ends of the wire if you can. **Use the solid contact probe or use the receiver alone.**

**EVAP SYSTEMS:** Checking for leaks in evaporative emission systems is simple. Start by pressurizing the EVAP system (do not exceed the recommended pressure). Now, sweep all the hoses and components of the system and listen for a hissing noise that would indicate a leak. Once the general area of the leak has been determined, move closer with the receiver to pinpoint the exact leakage source. **Use the hollow air probe or use the receiver alone.**

**INJECTORS:** Place the solid contact probe onto the injector to test and listen while the engine is running. You can hear the injector working plus hear the fuel flow. You may also want to shut off the engine and listen to make sure that the injector is not leaking fuel past the injector nozzles. If fuel is flowing, it will create a rushing noise in the headset. A good clean injector will make a sharp ringing clicking tone, while a dirty injector will have a muffled clicking tone. **Use the solid contact probe.**

**AIR BRAKE SYSTEMS:** The Marksman II can help locate leaks quickly in both vacuum assisted and air brake systems. In many cases, leaks can be detected from a considerable distance. After building up full pressure (in the case of air brakes), a casual sweep of the vehicle from one end to the other using the receiver can often locate the leak. Use of the headphones will reduce noise interference from the shop. If the first sweep does not locate the leak, trace out the entire air system piping at close range (1-2 feet or 0.3-0.6 m) with the receiver. Once the general area of the leak has been determined, the receiver probe is very useful to pinpoint its exact location. For maximum effectiveness, be sure that pressure is maintained in the brake system during the entire search. If no leaks are discovered, check the air horn, windshield wiper and other air-actuated equipment. Leaks in these accessories can produce an abnormal gauge drop. **Use the hollow air probe or use the receiver alone.**

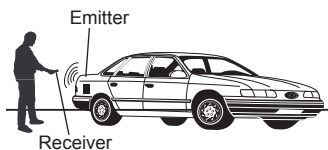
**TIRES:** Sweep the tire, including the rim and valve system, to search for leaks. A sweep with the ultrasonic receiver will locate even the smallest of leaks. The receiver normally finds leaks of sufficient magnitude before they cause downtime on the highway. In addition, you can put a soap solution on tires and listen for the bubbles to pop. **Use the hollow air probe or use the receiver alone.**

**LEAKING ENGINE VALVES:** All valves should emit a sound in a very close meter and sound pattern when the probe is placed on the intake manifold opposite the intake port. A suspect valve can then be positively checked, with the engine off, by bringing that particular cylinder to full compression and placing the probe on the valve stem. The “hiss” of escaping gas across the valve seat will be distinctly audible on the leaking valve. You can use the same procedure to check exhaust valves, but the signal intensity will be much greater. **Use the solid contact probe.**

**EXHAUST SYSTEMS:** With the engine idling, pulsation in the exhaust system can be detected with the receiver. Leak points normally give off a much louder and sharper sound. **Use the hollow air probe or use the receiver alone.**

**DOOR AND WINDOW GASKETS, BODY WEATHER-STRIPPING, DOOR AND TRUNK SEALS AND FUEL TANKS:**

When placed inside a vehicle, a completely empty fuel tank or any other enclosure, the activated emitter can easily locate leaks in weather-stripping, seals or the structure itself. **Use the hollow air probe or use the receiver alone.**





## ADDITIONAL APPLICATIONS

**HYDRAULIC SYSTEMS:** Partially blocked or bypassed valves in high-pressure hydraulic systems can be difficult and costly to find with conventional methods. Since hydraulic systems employ very high pressures, the intensity of the ultrasonic sound given off by an internal leak is extremely high and easily detected by the receiver. **Use the hollow air probe, solid contact probe or use the receiver alone.**

**WATER LEAKS IN ROOFS, WINDOWS OR DOORS:** Place the activated emitter below the suspected leak area. Check the suspected part of the roof, window or door with the receiver to isolate where the leak originates. This will also aid in the detection of any leaks in the area. **Use the hollow air probe or use the receiver alone.** (See figures below.)



## **CARE AND MAINTENANCE**

To clean exterior surfaces, wipe with a soft damp cloth.

When the battery LED flashes, the batteries are near the end of their useful life and will soon have to be replaced. See Batteries (Changing/Replacing/Disposal) on page 7.

## **WARRANTY AND LIABILITY**

Your Marksman II Ultrasonic Diagnostic Tool is of the finest design and craftsmanship. As such, Tracer Products warrants that when delivered it will be free from defects in manufacture.

Tracer Products' obligation under this warranty is limited to repairing or replacing, at the option of Tracer Products, any part(s) of the product which, if properly installed, used and maintained, proves upon factory examination to have been defective in materials or workmanship within two years from the date of delivery.

Tracer Products does not warrant items that deteriorate under normal use, such as batteries. In addition, Tracer Products does not warrant any instrument that has been subjected to misuse, negligence or accident, or has been repaired or altered by anyone other than Tracer Products.

This warranty is in place of all other warranties of quality. There are no other warranties either oral, written, express, implied or statutory. **IMPLIED WARRANTIES OF FITNESS FOR PURPOSE AND MERCHANTABILITY ARE EXCLUDED.** This warranty and your remedies thereunder are solely as stated in this manual. In no event shall Tracer Products be liable for special, indirect, incidental or consequential damages, nor for any damages arising out of delay in shipment or production.

## TECHNICAL SPECIFICATIONS

Sensitivity .....	Detects leaks or defects through a 0.004 in (0.1 mm) diameter orifice at 5.0 psig from a 12 in (30.5 cm) distance
Usage .....	Indoor or outdoor
Operating Temperature Range*	+32 °F to +122 °F (0 °C to +50 °C)
Storage Temperature Range .....	+14 °F to +140 °F (-10 °C to +60 °C)
Humidity.....	85% RH NC Max.
Altitude.....	6500 ft (2000 m)
Pollution Degree .....	2
Dimensions.....	Width: 4.0 in (10.2 cm) Depth: 1.5 in (3.8 cm) Length: 6.0 in (15.2 cm)
Weight .....	3 lb (1.4 kg)
Housing .....	Chemical resistant ABS
Battery Life .....	Approx. 165 hours
Power Requirement.....	2 standard "D" cell alkaline batteries
Power Consumption .....	26 mA, typical
Frequency Response .....	36,000 - 44,000Hz
Circuitry .....	Solid state
Overvoltage Category .....	2
Headphones .....	Full-sized noise-attenuating
Headphone Connector .....	3.5 mm phone plug

\*May be operated for a limited time in lower temperature environments.

## REPLACEMENT PARTS AND ACCESSORIES

Ultrasonic Receiver .....	TP-127298
Ultrasonic Emitter .....	TP-9368
Air Probe .....	127300
Contact Probe .....	127301
Headphones, Full-sized Noise-Attenuating .....	127302
Carrying Case .....	TP-9369



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