

# FISHER<sup>®</sup> RESEARCH LABS

## TW-6

### Pipe and Cable Locator



## Operating Manual

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# INTRODUCTION

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Since 1931, utility and construction craftsmen have looked to Fisher to set the standard of quality in the design and manufacture of locating equipment. The Fisher TW-6 is the damage prevention and utility locating “standard issue” tool for thousands of users across the globe.



**WARNING:** Batteries can contain hazardous materials and must be disposed according to the laws in your country.

This Category II radiocommunication device complies with Industry Canada Standard RSS-310.

Ce dispositif de radiocommunication de catégorie II respecte la norme CNR-310 d'Industrie Canada.

# RECEIVER

1. **Battery Life Indicator:** At one bar, plan to change batteries soon.
2. **Accessory Input:** Connection point for receiver accessories (for headphone connection see #6).
3. **Signal Strength:** Displayed numerically and with a curved bar graph.
4. **Sensitivity Adjustment Knob.**
5. **Sensitivity Toggle Switch:** For adjusting to high or normal range sensitivity settings.
6. **Headphones:** Accepts stereo or mono headphones that utilize 1/4" plug.
7. **Power Switch:** Pull out for ON, push in for OFF.
8. **Level Indicator Display:** The Level Indicator illustrates the angle of receiver to the ground. User can monitor this display to assist in both keeping the unit level during use and in holding receiver at 45° angle while calculating depth using triangulation (see page 14, determining conductor depth by triangulation).
9. **Speaker:** Produces the audible signal, which increases in volume and pitch as signal strength increases. The volume and pitch increase even after the meter has peaked at 99.



# TRANSMITTER

## 1. Battery Status Indicator:

**GREEN:** Good condition; over 9 volts

**AMBER:** OK, 7 volts to 9 volts

**RED:** Change batteries soon; less than 7 volts

## 2. Constant Tone Selection:

**A.** When Toggle Switch is in left position, continuous signal is generated/transmitted.

**B.** When Toggle Switch is in right position, the TW6 generates a warble tone.

## 3. Power: Pull out for ON, push in for OFF.

## 4. Accessory Output: Connection point for inductive coupling clamp or direct connection leads.



# ACCESSORIES



1. **Ground Rod/Harness Assembly (direct connect leads):** Provides a “ground” for greatest efficiency in CONDUCTIVE TRACING.



2. **3-Piece handle:** For use with “on handle” inductive searches.



3. **Handle Carrying Strap:** Allows you to lower handle closer to the ground for greater depth penetration and sensitivity in locating.



4. **Handle Carrying Case:** Provides protection and convenient storage for the 3-Piece handle.



5. **Carrying Case:** Protection for your TW-6 and storage for accessories, such as coupling clamp, headphones, mini probe and ground rod assembly.



6. **Headphones:** Stereo headphones are available for the TW-6. They are switch selectable from monaural to stereo and may not work with the TW-6 when switched to mono. You may prefer to use the stereo phones as volume is adjustable separately for each ear. The VCO sound is shrill and without a volume control on the mono headphones, the sound may be uncomfortable.



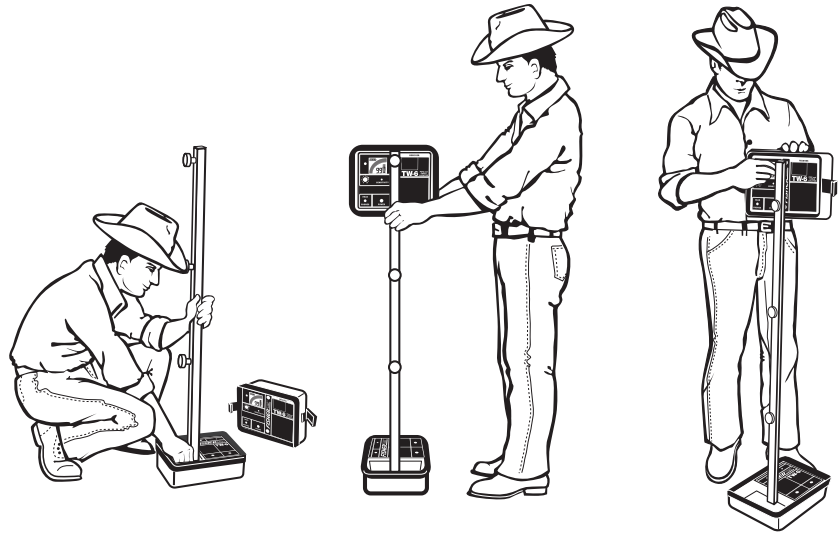
6. **Coupling Clamps:** Availability in 3" and 5" models (see coupling clamps page 19).

# MODES OF OPERATION

Your Fisher Model TW-6 allows two modes of operation: INDUCTIVE and CONDUCTIVE. In the INDUCTIVE mode, the Transmitter induces an electromagnetic field around a buried conductive target. The Transmitter radiates this field through both soil and water. There are two methods of operation in INDUCTIVE mode: (1) ON-HANDLE or (2) Stationary with the transmitter on the ground directly above and in line with the conductor for TRACING the path of a conductor.

The CONDUCTIVE mode operates by connecting the Transmitter directly to an exposed portion of a pipe or cable with the Coupling Clamp or Ground Rod Assembly.

## ON-HANDLE OPERATION



## HOW TO ASSEMBLE

1. If using the optional 3-piece handle, insert the two end sections into the central section and turn the knobs until they are "finger-tight".
2. Place the Transmitter on its back and insert handle end with one screw into V-shaped slot.
3. Turn the knob until it is "finger-tight".

4. With the Transmitter still on its back, align the two holes in the panel of the Receiver with the knobs.
5. Turn the lower knob of the two knobs until it is "finger-tight". Turn the knob with the arrow until the spring is compressed and the panel is pulled within 3/8" of the handle at the end.

### HOW TO TUNE

1. Check batteries on both Transmitter and Receiver.
2. Place the Receiver Sensitivity Switch in the NORMAL position.
3. Turn SENSITIVITY knob to 7.
4. To turn ON, pull POWER switches on Receiver and Transmitter.
5. Pick the unit up by the handle and balance it so that it is level with the ground and at normal carrying height (arms length). For a deeper search, hold with the carrying strap fully lengthened. In order to operate and search while hanging on the strap closer to the ground, you must tune it in this lowered position. On some highly mineralized ground and some asphalt, you may not be able to use it with the strap fully lengthened, evident by an inability to achieve a "null". Not reaching a null can also indicate the presence of nearby metal.

**CAUTION:** *Never attempt to tune the TW-6 in the presence of metal objects like cars, metal walls, roofs or heavy metal reinforcements in any structure. Their presence will make proper tuning/balancing impossible.*

6. Turn front knob on handle counter-clockwise, until lowest meter and speaker indications are reached. You have reached the lowest point if a 1/8 - 1/4th turn in either direction results in an increase in sound and meter reading. If at the lowest point there is still sound and meter reading, turn down sensitivity slowly until meter

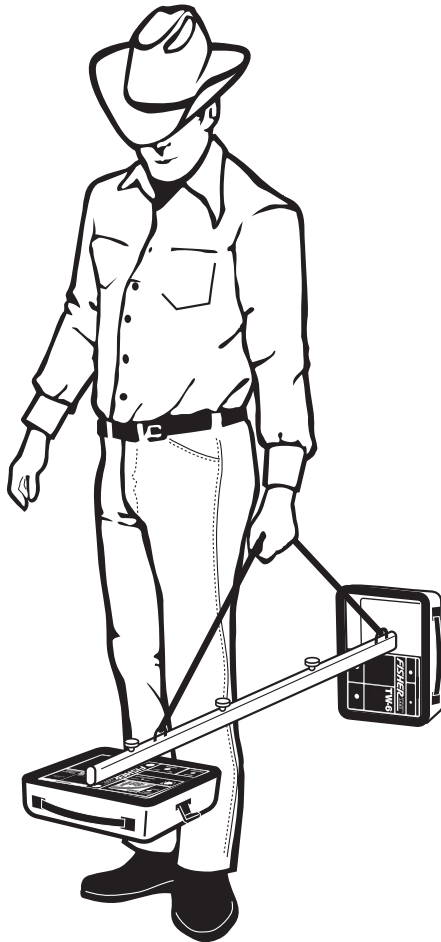


goes to zero.

If you can turn the front knob more than 1/4th turn without an increase in sound and meter reading, turn the sensitivity knob up from 7 to 8 and try again, going through the null zone, making sure it does not exceed 1/4th turn. You may need to readjust the sensitivity knob to give you a zero reading at the balance point.

**CAUTION:** *Keep away from cars, fences and metal objects during this procedure.*

You are now ready to locate. Crossing over buried metal causes an increase in sound and meter reading.



## **INDUCTIVE LOCATING (with handle)**

Use Inductive Locating when you want to find metal objects or locate lost or unknown metal pipes and cables. Walk at a right angle toward what you assume to be the conductor's position. As you near the conductor, the speaker sound and meter indication will increase. They will reach maximum readings when you are directly over the conductor. Remember, on the TW-6, the sound volume and pitch can increase after the signal strength reaches maximum. This allows you to do most of your locating without multiple readjustments of the Sensitivity knob.

To get a precise fix on the location, make a mark at your feet when signal strength reaches maximum. Cross over the pipe, turn around and come back. Make a second mark when signal strength returns to maximum. Measure between the two marks and bisect the distance. That is where the conductor is located.

To establish the path of a pipe or cable (conductor) move "up" and "down" the line 15 or 20 feet and locate again. From these three locations you should be able to draw a straight line (unless pipe has turned). Careful additional locations may be necessary if no prints of the area are available.

It may be necessary to reduce sensitivity with the knob when the pipe or cable is large and/or shallow. If the meter signal strength has peaked and sound is at a high level, you will want to reduce the sensitivity to where the peak signal is at a point less than 99 as you move in half or quarter steps back and forth.

After crossing over the conductor, the signal strength will drop as you move away from the conductor.

## **HIGH POWER (with handle)**

The Sensitivity knob will need to be lowered to about 3 or slightly less to get the meter reading down to zero with no sound when tuning/balancing. As you approach a pipe or cable lying beneath the ground, the signal strength may be low, approximately 20 to 30 and it can be difficult to identify the peak.

Now increase the Sensitivity until the signal strength reaches 70-75. As you move forward and backward, you will easily see a peak on the meter. Mark the spot on the ground where you have stopped, with both feet together. Then go on beyond the conductor, turn around and approach the conductor in the same way, stopping with feet together at the highest meter reading and mark the spot on the ground. Measure between the two points, bisect it and you have the centerline of the conductor.

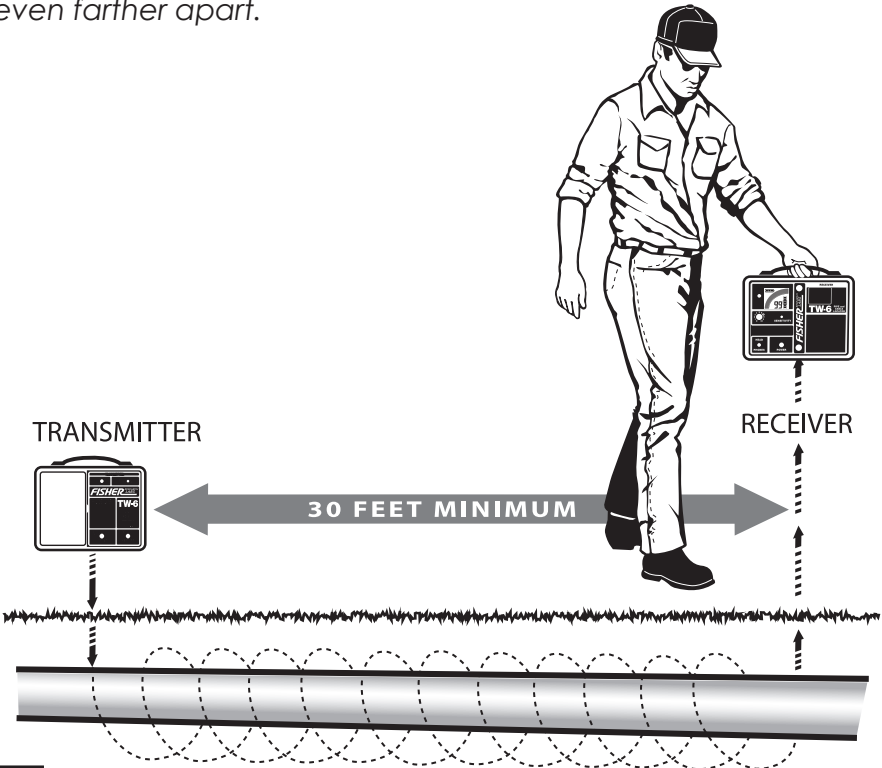
Be aware that when you use HIGH power on the handle, you will need to be even further away from vehicles, metal buildings and metal fences to avoid sensing them as well.

## INDUCTIVE TRACING (without handle)

Use Inductive Tracing as a one-man operation when you know a starting point of the object pipe or conductor. You can maximize signal strength by having the bottom edge of the Transmitter directly over and in line with the conductor you're tracing. With the Receiver on the ground, control-panel-up, you will get no signal (a "NULL") directly over the conductor and an audible signal when the Receiver is moved to either side of the conductor.

If you place the transmitter and receiver too close together "direct air coupling" will result as the Receiver picks up the Transmitter's signal directly through the air, overpowering the signal coming through the ground. If this happens, you can either (1) turn the SENSITIVITY control down until you lose the air signal, or (2) simply move the receiver further away until the air signal fades.

**NOTE:** With the SENSITIVITY knob at full and the Sensitivity Selection Switch set to NORMAL, the two halves should be at least 30 feet apart to avoid air coupling. At HIGH SENSITIVITY, they must be even farther apart.



## **INDUCTIVE LOCATING WHEN ONLY APPROXIMATE POSITION OF A LINEAR CONDUCTOR IS KNOWN**

This search method requires two operators. Each holds the unit with its face towards him and parallel to the other's instrument. Standing at least 30 feet apart, they walk parallel to each other from the curb toward the opposite side of the street. When the two operators are directly over the pipe, the receiver meter and speaker will indicate the location. The pipe is directly below the point at which the maximum signal occurs.

If only one operator is available, he should begin by placing the transmitter over and in line with an assumed position of the buried conductor. While maintaining a distance of at least 30 feet from the transmitter, hold the receiver parallel to the other instrument and begin to walk forward until the signal reads its maximum indication. In a one-person search, you may find it necessary to move the transmitter several times in order to be precisely over the buried conductor.

## **PINPOINTING CENTER OF THE PIPELINE**

After determining the position of the pipe, set the transmitter down on its bottom edge and in line with the indicated position. Then, at a distance of at least 30 feet, hold the receiver with its backside down and begin moving the receiver from side to side over the general location line of the conductor. This back and forth motion will give a null directly over the position of the buried conductor.

## DETERMINING CONDUCTOR DEPTH BY TRIANGULATION

This procedure is only possible when the transmitter is close enough for the receiver to receive a strong and clear signal.

Once you have determined the exact centerline of the conductor (either Inductively or Conductively), place the receiver above and parallel to it. Hold the receiver as close to the ground as possible. Now, tip the receiver back until the depth level indicator is in the center position. The receiver will be at a 45-degree angle to the level ground. See *illustration*.



Care should be taken to maintain the 45° angle, as a few degrees of deviation will affect the final depth analysis. The operator should be holding the receiver at 45 degrees and facing toward the conductor centerline. Now, back away slowly, at a right angle to the conductor, keeping the level indicator as steady as possible. The meter indication should manually be adjusted by means of the sensitivity control to stay on scale in order to observe the point where the signal strength will fall to a minimum signal. After this point, the signal begins to increase again.

Position the receiver at the minimum or null point. Measure the horizontal distance from the centerline of the conductor to center of the fastener, which holds transmitter and receiver together. This distance, minus the distance of the center of the locator loop above the ground distance (5") is the depth of the conductor.

If the conductor is buried in sloping ground, make a depth determination on each side of the conductor and average the two distances to find the cable depth.

A tracer probe with its smaller receiver coil in the tip, is quicker and easier to use, hence it yields greater accuracy in depth finding and tracing. The same principle of triangulation is used when using the receiver or receiver with tracer probe.

## **LOCATING MANHOLE COVERS, VALVES, TEES AND RISERS**

These jobs are best performed on-handle in the Inductive Mode. To find a valve, tee or riser, locate the main pipe using any of the previously discussed methods. Then, holding the center of the handle with the receiver leading (face up), walk alongside the main pipe. Be sure you're far enough away from the centerline of the pipe to have a low or zero reading. When you cross the sought after valve, tee or riser, the meter and speaker will signal a larger mass of metal indicating the valve. At that point, you can cross and return over the suspected valve location from 3 or 4 directions to pinpoint its location.

In the case of the paved-over manhole cover, search systematically by walking out a grid pattern, each "line" of which should be 4 feet apart. Practice this grid technique with a visible cover so that you can get the "feel" of it.

## **LOCATING PIPE WHEN OTHER LINES ARE CLOSE BY**

Two methods of Inductive Tracing may be employed. In the first method, set the transmitter vertically and parallel to the line to be traced, approximately three to five feet from the pipe you're tracing and away from the pipe not wanted.

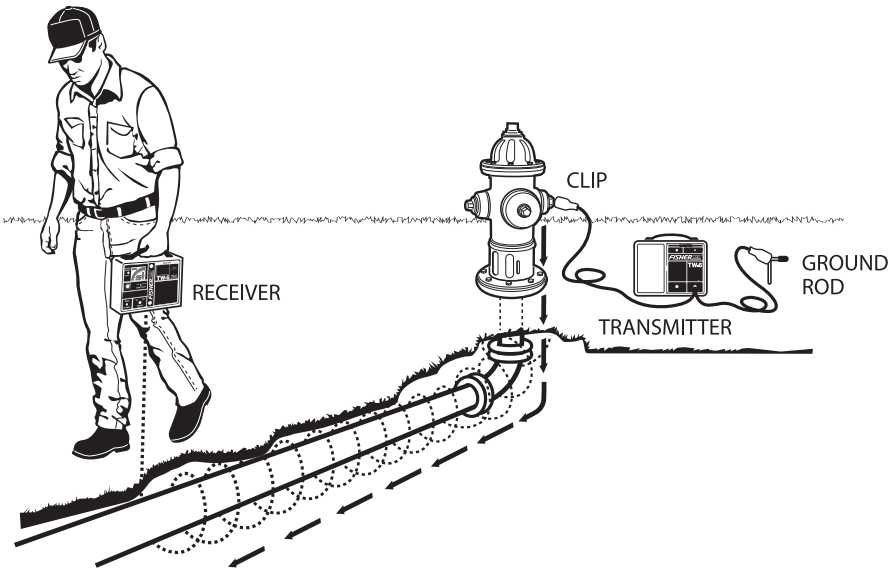
Now, follow normal Inductive Tracing instructions. To locate the other pipe, move the transmitter to the opposite side, three to five feet away from the second pipe. In the second method, set up the transmitter so that its plane points toward the pipe desired. This positioning induces a maximum field in the pipe desired and a minimum field in the secondary pipe.

## **CONDUCTIVE TRACING (without handle)**

The most accurate method of tracing in a congested area, with multiple pipes or conductors close together, is CONDUCTIVE tracing. In the CONDUCTIVE mode, the transmitter energizes the pipe through direct connection. Before attaching the ground rod clamp to the conductor, clean the conductor with a wire brush (this creates a good metal-to-metal contact).

After cleaning, plug the jack into the transmitter and secure the clamp to the pipe or non-energized cable. Place the transmitter in an upright position and as far away from the pipe as possible to the side opposite any other lines. As far away as possible means it will be at 90°.

If you are working in an area with several other conductors near the pipe or cable you want to trace, place the ground plate as close as possible to the point at which you fasten the clip to the pipe or cable. This will reduce the signal strength and reduce the amount of signal induced into another nearby conductor, giving a more concentrated signal in the pipe or cable you are tracing. Never stretch the ground plate across a conductor running parallel to the pipe or cable you are tracing, because even if you are not hooked up to the conductor you crossed over, the signal has





to cross back past the path of this conductor and will induce a certain amount of signal into it. This signal can mislead you when tracing it out.

If you're working on pavement, simply lay the Ground Rod/Harness Assembly on its side, parallel to the conductor in the direction of the tracing. Weighting it down with a rock or someone standing on it makes it a better ground contact. If the plate is weighted down in a puddle or at least if the pavement is wet, tracing distance is improved. You may pour some water on the pavement to improve ground contact.

# TRACING PROCEDURE

Turn the transmitter ON and turn receiver SENSITIVITY knob all the way up in NORMAL. Then, when the conductor is located, turn SENSITIVITY down to get a precise indication of the location. Use NORMAL for ordinary tracing, HIGH for extended tracing. In the Conductive Mode, you can have Transmitter and Receiver as near to each other as 20 feet apart and closer yet if you use the Tracer Probe, without air coupling occurring. With HIGH power, the distance increases.

With settings and connections completed, the operator need only walk out his trace while paying attention to signal strength over the conductor. As in the Inductive Mode, the receiver should be carried vertically and parallel to the pipe or cable being traced. However, once the position is discovered, you may turn the receiver to a horizontal position to get a pinpoint reading.

If you're dealing with a maze of pipes, trace each line and mark its surface location on pavement with colored chalk or spray paint as you locate it. Extra long yellow or white golf tees are very handy markers when locating over turf or open ground.

Another tip...start tracing operations away from the congested location. The pipe is then carefully traced into the desired area with little chance of false indications. The Tracer Probe also helps reduce spurious signals from nearby pipes and cables.

## **The Tracer Probe**

As you trace out the pipe or cable, signal strength gradually diminishes. When you reach the limit of NORMAL, switch to HIGH sensitivity and adjust the sensitivity knob for a sharp null over the conductor you are following.

The tracer probe designed especially for the TW-6 is slightly shorter than the earlier model and does not need a separate SENSITIVITY knob. It can be used effectively with the earlier TW-5 model. The Tracer Probe for the TW-5 can be used with the TW-6 but reduces tracing distance.

Once you have located the pipe or cable with a sharp "null", back away at right angles, dragging the tip of the Tracer Probe on the ground and maintaining the level indicator centered in its

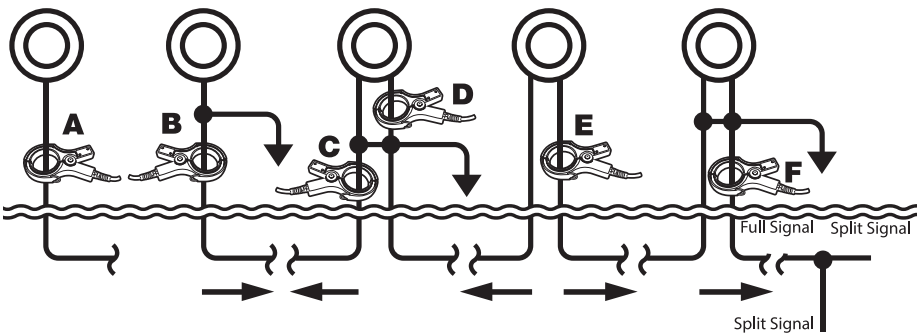
circle. You need to be close enough to the transmitter for a strong signal so that the sound will quit or “null” as you back away and then resume again as you move backwards. You measure from the middle of the null area back to the centerline of the pipe or cable and that is its depth.

## **COUPLING CLAMP**

Use the Coupling Clamp to Inductively energize and trace without a metal-to-metal contact. Tracing distance will be less than when using the ground rod assembly, so there is no advantage to using the coupling clamp on pipes, unless a non-conductive wrapping prevents bare metal contact.

Begin by plugging the Clamp into ACCESSORY OUTPUT on the transmitter. Place Clamp around cable or other conductor (make sure jaws are completely closed). Turn receiver and transmitter ON and precede using tracing techniques as described earlier. The conductor must make a closed loop, or circuit, or be grounded for best tracing results.

It is useful to carry a “jumper” with two clips and a rod to be driven into the ground to be sure of the ground. Two Coupling Clamps can be used together to perform manhole-to-manhole and drop-to-junction types of work. Plug the second Clamp into receiver ACCESSORY INPUT jack. Then, test different strands with the receiver Clamp to find your signal.



# LOCATING NON-METALLIC PIPES

One method is to run an electrician's "fish-tape" or plumber's "snake" down the pipe and connect the transmitter to it using the ground plate assembly. Attach the ground plate assembly clamp to the tape or "snake" and trace the pipe with receiver or receiver and tracer probe. Blockages in pipes can be located this way too in that the tracing signal will stop where the tape or "snake" ends at the stoppage. Tracer tape which is aluminum foil tape sandwiched in printed mylar is available from 3 or 4 U.S. manufacturers in two-inch widths and wider. It can be laid into the trench above a non-metallic pipe. When laid according to the tape manufacturer's instructions, the tape and hence pipe can be located Inductively or Conductively. When laid only 8" or 10" below the surface, it can also be traced with a valve and box locator such as a Fisher M-66 or M-97.

# OPERATING HINTS

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To develop your technique, practice with known pipes and cables to thoroughly familiarize yourself with the TW-6. Of particular importance in this regard is the SENSITIVITY knob. Learning to vary the SENSITIVITY knob and studying the effects of those variations remains the key to getting the most precision out of the instrument. These practice sessions will not only allow you to get used to how the TW-6 responds to different kinds of pipes and cables, but it will also teach you how to interpret each reading.

When using the TW-6 on the handle in the presence of CONDUCTIVE SOIL (those with high mineral salt content and usually rather damp), it may be necessary to turn down the SENSITIVITY control from the suggested position. With each repeated reduction, the operator should readjust the front knob as given in the "How To Tune" instructions.

When locating near-surface and/or very large pipes, you can sharply decrease the width of indication by tuning the SENSITIVITY control down or counter-clockwise. This narrowing of the indication will allow more accurate pinpointing.

The TW-6 has a slightly slower response than earlier models. This is more noticeable at extended tracing ranges. Be sure that when you "wag" either the receiver or the Tracer Probe, you do so slowly enough for the receiver to sense the signal emitted by the underground pipe or cable.

If the signal remains reasonably strong as you are tracing out a pipe or cable and it mysteriously disappears, use the "null method" of locating with the receiver instead of the "signal method". Sometimes at extended ranges in HIGH power, the "null method" will give you greater tracing distance, however, usually the signal method will give a longer trace.

# CHANGING BATTERIES

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Turn the instrument over on its face (position is the same for both transmitter and receiver) and remove access plate with coin or large blade screwdriver.

Lift the battery pack out carefully. Turn the battery pack slightly and unsnap the battery connector. Change all eight batteries. Then reattach the connector to the pack. Slip the battery pack back into its compartment and do battery test. Refasten the access plate.

Use alkaline batteries. Transmitter battery life is approximately 25 hours. Receiver battery life is approximately 30 hours.

**WARNING:** Batteries can contain hazardous materials and must be disposed according to the laws in your country.

**CAUTION:** *Do not try to recharge the batteries that come with the TW-6, or any other batteries, except Ni-Cad rechargeables.*

# SPECIFICATIONS

	<u>Transmitter</u>	<u>Receiver</u>
Operating Frequency.....	81.92 kHz +.005% .....	81.92 kHz +.005%
Batteries.....	8 AA Receiver (NEDA 15) 8 AA Transmitter (NEDA 15)	
Weight .....	2 1/2 lbs. (1.1 kg) .....	3 lbs. (1.36 kg)
Sensitivity .....	N/ANormal: 400 uV typical High: 8 uV typical	
Signal-to-noise ratio .....	N/A .....	110dB
Headset Impedance .....	N/A .....	600 ohms (mono) N/A..... 8 ohms (stereo)
Dimensions .....	11 1/2" x 9" x 3.....	11 1/2" x 9" x 3" (29 x 23 x,7.6 cm).....(29 x 23 x 7.6 cm)
Operating Temperature .....	-10°F to +120°F, (-23°C to +48°C) depending on batteries used.	
Total Weight .....	5 1/2 lbs. (2.5 kg)	
	-(without handle or accessories, ground plate assembly or operating manual).	
Total Shipping Weight .....	6 3/4 lbs. (3 kg)	
	-(including only ground plate assembly and operating manual.)	
Total Shipping Volume .....	69 cu. ft. (119.5 liters)	
Field Strength: 17.5dBuV @ 300 meters, 81.92KHz.		

# USING HEADPHONES

Using headphones (not included) improves battery life, and prevents the sounds from annoying bystanders. It also allows you to hear subtle changes in the sound more clearly, particularly if searching in a noisy location. For safety reasons, do not use headphones near traffic or where other dangers are present. This device is to be used with interconnecting cables/headphone cables shorter than three meters.

# FISHER<sup>®</sup> RESEARCH LABS

## QUALITY

Fisher detectors are renowned for their quality. Each detector is handcrafted in the USA with pride.

## PERFORMANCE

The worldwide underground utility industry relies on Fisher. Our instruments are durable, dependable and locate deeper.

## REPUTATION

Fisher produced the first patented metal detector in 1931. For over 85 years, the Fisher logo has been a mark of excellence.

## SERVICE

***Should you have any questions or problems, contact:***

### **FISHER RESEARCH LABS, INC.**

1120 Alza Drive, El Paso, Texas 79907

Tel 1-800-685-5050 Fax 915-225-0336

www.fisherlab.com email: info@fisherlab.com

## **2-YEAR LIMITED WARRANTY**

This Fisher instrument has been rigorously tested before shipment. Fisher Research Laboratory (FRL) warrants this instrument to be free of manufacturing defects for a period of 2 years after the original date of consumer purchase. This warranty gives you specific legal rights and you may also have other rights that may vary from state to state. During the warranty period, FRL may elect to repair or replace a defective instrument, free of charge, return postage excluded.

This warranty excludes headphones, all batteries and damage caused by battery leakage regardless of the type of battery used. Also excluded is damage caused by wear, misuse, alterations and negligent handling or any abuse, which in the opinion of FRL, caused the failure.

This warranty is void in the event any unauthorized person opens or repairs the instrument.

**THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. FRL DOES NOT WARRANT SUITABILITY TO SPECIFIC USE. FRL SHALL IN NO EVENT BE LIABLE FOR ANY DIRECT, INCIDENTAL, CONSEQUENTIAL OR INDIRECT DAMAGES.**

### ***This warranty is non-transferable.***

Maintain proof of purchase. Proof of purchase must accompany warranty claim. Should warranty service become necessary, contact FRL for the name of the nearest authorized Fisher Repair Center or call 915-225-0333 for return authorization. Please include your dated proof of purchase and a complete description of the problem.

### **NOTE TO CUSTOMERS LOCATED OUTSIDE U.S.A.**

This warranty may vary in other countries; check with your distributor for details.

Warranty does not cover shipping costs.

### ***Proof of purchase is required to make a claim under this warranty.***

According to FCC part 15.21 Changes or Modifications made to this device not expressly approved by the party responsible for compliance could void the users authority to operate this equipment.

This device complies with FCC Part 15 Subpart B Section 15.109 Class B.

*Not to be used with conductive tracing cables longer than 6.5' (1.98 m)*