INSTALLATION AND TESTING PROCEDURES FOR ERM LEAK DETECTION

Materials & Equipment

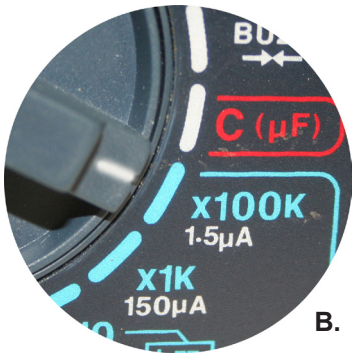
MATERIALS:

1. Teflon Coated Insulated Wire with Crimps
2. Shop Rags
3. Standard ANALOG Ohmmeter
4. Wire Crimping and Stripping Tool

1. Each piece of pipe, <u>as it arrives at the jobsite, must be checked for isolation and continuity</u>.

Isolation and Continuity Check: Switch your analog ohmmeter to its high-end resistance scale R x 100k (see images A & B below). Touch one lead to the copper wire and the second lead to the carrier pipe (see figure 1). The bare metal of the carrier pipe shall be exposed at all locations where the probe (or copper wire) will make contact. For good isolation, the reading on your ohmmeter should be close to infinity for any single piece <u>and not less than 1 Million Ohms</u> for an entire run. For example, in image "B" below with the meter on x100k setting, a blue "200" equates to 20 Million Ohms, or a blue "10" equates to 1 Million Ohms. For a single piece, the needle should not move past the "200" marker, and for the entire run the needle should not move past the "10". If this happens, make sure that moisture is not present at the ends of the pipe and clean any excess mastic from the wire. Use a propane torch with a light billowy flame to get rid of the moisture. If the foam catches on fire, quickly extinguish with a rag.

A.



B.

Ex. 50 x 100K = 5,000,000

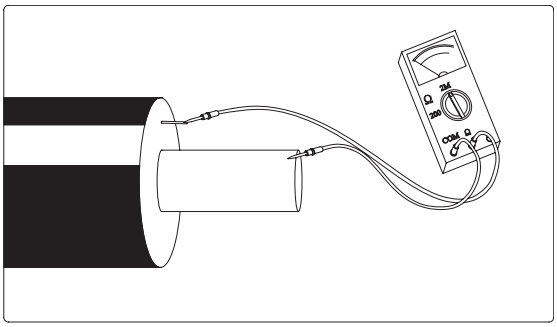


Figure-1: Isolation Reading

After isolation check, the continuity check must be performed. "Short" the leak detection wire to the bare pipe at the opposite end of the pipe. It is best if a partner is used that can place the wire into and out of contact with the steel pipe. The instant this occurs, the Ohm reading should drop to zero. This zero reading occurs when the Ohm reader's needle pegs to the right (zero resistance). See Figure- 2.

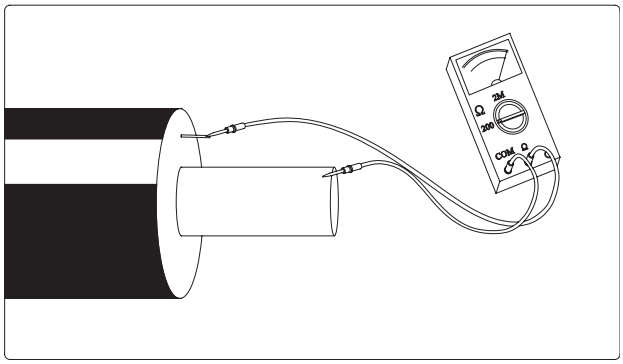


Figure-2: Continuity Check

2. After several pieces of pipe have been welded in the trench and the section has passed the hydrostatic field test, we are ready to insulate the joints.

a. Make sure that the entire joint area is completely dry. Any moisture in the joint will adversely affect the initialization and operation of the leak detection system. **Perform and record on the attached form isolation and continuity checks on the two pieces you are about to seal with a joint closure** to ensure that each piece reads close to infinity, and when all pieces are connected that the system reads 1 Million Ohms.
b. Use a propane torch with a light billowy flame to remove any residual moisture and dry the area out. Even if the area already appears dry, the torch should still be used to make certain all residual moisture has been removed. Additionally, the foam immediately surrounding the wire should be dug out approximately 1" around the wire and 1" deep to remove foam that may have surface moisture trapped inside.
c. Next (HT-406 Only), sectional insulation is to be placed over the joint and secured with duct tape. If the foam does not initially fit, measure the distance between the factory end and cut to fit. Make sure the insulation fits without any gaps and the embedded copper wire is visible.
d. Trim the bare copper wire so that it extends just beyond the face of the insulation. Crimp the bare wire with the Teflon coated wire at each end (see fig. 3). Insure there is some slack in the Teflon coated wire.

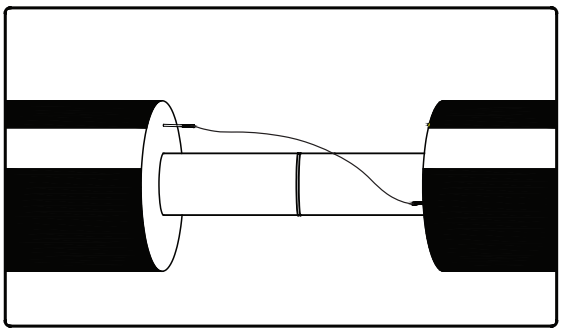


Figure-3: Crimping Teflon Coated Wire

e. Make sure that the crimp is attached securely by tugging firmly on either side of Teflon coated wire. Additionally, make sure that the crimp and bare copper wire cannot touch the steel carrier pipe. **Perform an isolation and continuity test on the joint** as described in Section 1 of these instructions. After the tests are passed install your joint kit per the projects joint kit installation instructions (*Remember fusion joints require factory training, which is already included in the product sales price. You must remember to schedule this visit!).*
f. **After the joint is insulated and sealed, perform an isolation and continuity check on the entire run of installed pipe.** One person will be at the last piece of pipe currently installed in the ditch. This person will attach the ohmmeter and perform the tests as described in Section 1. A second person will be at the opposite end of the run in order to 'short' the run when instructed.*
g. Repeat steps a - d to insulate each remaining joint. Isolation should meet or exceed 1 Million Ohms for up to 2000 ft.

* For long runs, the use of a second person to short the opposite end may not always be practical. For a shortcut, see figure 4 where the supply and return pipes are grounded together via a tack welded metal bar, and the ERM wire is connected between the supply and return. Now you can "short" the system right next to the joint you are reading.

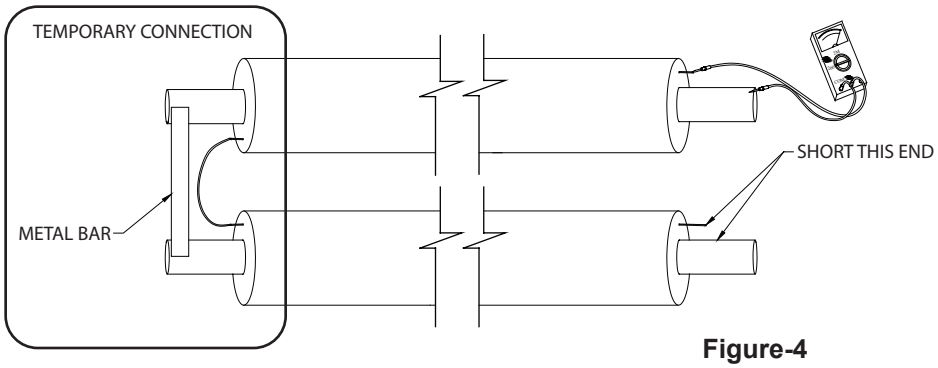


Figure-4

Additional Notes:

1. **Performing isolation and continuity checks on the pipe as it arrives at the job site is imperative.** This ensures that if any pipe was damaged during shipping, repair or replacement of the piece can be performed prior to installing the pipe in the trench. Thermacor will not be responsible for any cost associated with removing the pipe from the trench, and then reinstalling a piece that had to be repaired.
2. **Performing isolation and continuity checks after each individual joint kit is installed is imperative.** This is because if a joint is connected improperly, you will know immediately and be able to identify and repair the bad joint immediately. If the checks are performed after a string of joints are installed, you will not be able to identify the individual bad joint without opening and checking each joint or paying for a Thermacor factory technician to travel to the job site with a TDR machine to locate the bad joint.
3. **Performing isolation and continuity checks on the entire run of installed pipe prior to backfill is imperative.** This will prevent costs associated with re-excavation should the system not be connected properly.
4. Ambient moisture, especially in high humidity regions, will deteriorate resistance readings. As more and more joints are connected, these joints will act as a circuit in parallel and further diminish the resistance reading. To prevent this, closely follow the steps detailed in Section 2.a of these instructions. This will prevent residual moisture from giving you poor readings.
5. Connections through manholes are possible. The crimp and testing of this wire is the same as a regular joint. Access to the leak detection wire and carrier pipe should be made possible through the field applied vault insulation as shown in our vault detail. Contact Thermacor if you require a copy of this detail.
6. Resistance readings for the entire system should not drop below 1 Million Ohms. If this happens during installation, you are not drying the pipe enough to remove the residual moisture. A dry system is important because every additional joint that is connected in the system will cause the reading to drop.
7. This system includes a continuous monitoring panel. The panel should be mounted inside the building at the location the pipe enters that building. One lead of the panel needs to be attached to the copper wire and the other lead to the steel carrier pipe. The panel should then be plugged into a standard power outlet.

THE IMPORTANCE OF EARLY DETECTION OF A BAD CRIMP, BROKEN WIRE, OR SHORTED WIRE CANNOT BE STRESSED ENOUGH. THIS IS BECAUSE REPAIRS AND CORRECTIONS CAN EASILY BE MADE TO A PIECE PRIOR TO A PIECE BEING WELDED IN THE TRENCH AND ESPECIALLY PRIOR TO BACKFILL. THERMACOR TESTS EACH PIECE AS IT LEAVES THE FACTORY, BUT NEVERTHELESS, DURING SHIPPING AND HANDLING, PIECES CAN BE DAMAGED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT THE SYSTEM IS CORRECTLY CONNECTED PRIOR TO BACKFILLING THE TRENCH.

FOR ANY QUESTIONS PLEASE FEEL FREE TO CONTACT THERMACOR DIRECTLY AT (817)-847-7300.

THERMACOR	LEAK DETECTION INSTALLATION INSTRUCTIONS	FKII 14.604
	ERM - ELECTRICAL RESISTANCE MONITORING	11.19.09

LEAK DETECTION SYSTEM DIAGNOSIS, POST- INSTALLATION

REVIEW THE FOLLOWING IF YOU RECEIVE BAD READINGS WITH YOUR LEAK DETECTION SYSTEM AFTER INSTALLATION.

The following steps should be taken if a leak is suspected in your underground pre-insulated piping.

1. **If the Alarm Panel goes into alarm, perform the following**.
    1. Turn off the power to the Panel
    2. Disconnect Lead Wires at the Terminal Strip
    3. Use a Hand Held Ohmmeter to take a resistance reading between the copper wire and the steel pipe. Make sure you are connecting to bare metal on the steel pipe. You will need to provide the resistance reading to either a Thermacor Sales Representative or a Thermacor Field Representative.
2. Perform the following steps based on the resistance reading:
    1. **Resistance ≤ 5000 Ω (5 KΩ)**
        - Contact a Thermacor Field Service Representative to setup a site visit to isolate the problem*. The Representative will use a TDR to isolate the failure location. If you have a TDR at your facility, you can isolate the failure yourself**. Be sure to forward the TDR readings to Thermacor to validate the failure.
    2. **Resistance ≤ 100,000 Ω (100 KΩ) and >5000 Ω (5 KΩ)**
        - Take additional readings between the lead wire and the pipe. Remove any jumper wire and take a reading as close to where the wire exits the pipe as possible. Take readings on both terminal ends of the piping (where it enters the manhole or building.) If multiple runs are connected, disconnect additional runs and test each run independently. All readings should be very similar (within 10% of the original reading.)
            - If all readings are similar, inspect to make sure the valve pit is dry and no moisture is present on the end plate/end cap.
            - If the readings keep dropping, try to isolate the section with the lowest reading. Re-evaluate the resistance value and follow the appropriate steps.
        - Provide your Thermacor Sales Representative with the resistance reading.
        - Monitor the resistance every other day for 2 weeks and provide the readings to your Thermacor Sales Representative.
            - If the readings stay the same or improve, the original reading might have been caused by residual moisture which has dried due to system operation. Continue to take a reading once a month for 12 months to ensure the resistance does not drop.
            - If the reading deteriorates (by greater than 10%) over the 2 week period, contact a Thermacor Field Service Representative to schedule a site visit*. The Representative will analyze the routing using a TDR machine. If you have a TDR machine at your facility, you can try to isolate the system yourself**.
    3. **Resistance > 100,000 Ω (100 KΩ)**
        - Your Panel has been damaged. Contact your local Thermacor Sales Representative to replace the ERM Panel.
3. A leak or short in the system will be signaled by an event on the TDR, represented as a sharp dip in the wave form. It is critical that you take several readings from different locations (i.e. different buildings and/or valve pits) because this will allow you to most accurately pinpoint leaks**.

*Water flashing to steam on a hot pipe, as occurs during a leak, will deteriorate the foam insulation. However, this deterioration is gradual, not immediate. Therefore, from the time of a leak, an owner still has time, potentially weeks, to arrange to have the leak located, excavated, and repaired before significant damage occurs to the system.

**It is important to note that due to the manufacturing processes, there is more linear feet of wire in a system than linear feet of pipe. Therefore, taking TDR readings at several terminations is critical to get an accurate location of the leak. This minimal extra effort up front, to accurately locate the leak, will minimize potential excavation work.