SENSOR INSTALLATION

The sensor is 7/8" in diameter by two inches long and easily installed. The basic procedure is to make a hole with a 7/8" diameter rod to the desired sensor depth. With coarse or gravelly soils, it is sometimes difficult to get a snug fit between the sensor and the soil. With this situation, making an oversized hole (1"-1 1/4") may be necessary. Then prepare a "grout" of the soil and water and pour it down into the bottom of the hole. Push the sensor down to the bottom of the hole (a piece of 1/2" class 315 PVC can be solvent welded to the sensor collar to provide a permanent stake). If the PVC is not left in place after sensor installation, carefully backfill the access hole to the sensor. Specific instructions are included with each shipment.

SENSOR MAINTENANCE

The sensor is manufactured from non-corrosive parts and lasts for years. Once the sensors are installed, there is no future need for maintenance. With permanent crops such as trees and vines, the sensors may be left in place all winter, providing your cultural operations would not disturb them. With annual crops, where field operations are required, removal of the sensors prior to harvest is a standard practice. If the sensors are removed, simply clean them off and store them in a dry area until spring.

HOW THE WATERMARK WORKS

The patented **Watermark** Sensor consists of two concentric electrodes buried in a special reference matrix material that is held in place by a stainless steel case. The matrix material has been selected to reflect the maximum change of electrical resistance over the growth range of production crops. Soil moisture is constantly being absorbed or released from the sensor. As the soil dries out, the sensor moisture is reduced and the electrical resistance between the electrodes is increased. This resistance is read by the **Watermark** Meter.

The **Watermark** Meter, Model 30KTCD-NL, converts the resistance to centibars and gives a digital readout of soil water suction. It has the capability of inputting the soil temperature to compensate for its effects on the reading. This fine-tunes the data.

If the sensor is being used with a data logging device, sensor excitation current is 5 VAC, 100 - 120Hz (square wave) and sensor output is 500-30,000 ohms of electrical resistance which equates to 0-200 centibars of soil water suction (non-linear).

YOU — THE MANAGER

The concept of soil moisture measurement in managing irrigation schedules to meet crop "need" has been demonstrated for many decades. It's not just simply a matter of conserving water and energy, although this has become a most critical factor. When you irrigate precisely, you can indeed achieve these savings, but the real bonus from good management comes in the area of better production and healthier crops for agriculture, and in the landscape environment by healthier, longer living ornamental plants and turf. These results however, are not achieved by guesswork: the key ingredient is YOU – The Manager! Tools such as the **Watermark** give you the extra advantage needed to be successful. Why not ask your irrigation advisor to help you add soil moisture measurement to your management program?

IRROMETER CO., INC.

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WATERMARK

Soil Moisture Sensor

For over sixty years, plant scientists and agronomists have verified the value of actual soil moisture measurement as the most effective method for precise irrigation scheduling. These in-field measurements allow an irrigation manager to know exactly how fast the soil is being depleted of moisture, and WHEN to initiate an irrigation cycle to replenish soil moisture for maximum plant growth. By obtaining soil moisture readings in different areas of the field, and at different depths in the root zone, the manager can also establish HOW MUCH water to apply, from experience and good record keeping. This "Irrigation to NEED" results in:

- Higher Crop Quality
- Increased Crop Yields
- Lower Water Costs
- Lower Energy Costs
- Prevention of Excessive Fertilizer Leaching

IRROMETER CO., INC.
Riverside, California

WATERMARK

The **Watermark** is a solid state, electrical resistance type sensor, in use since 1985. Unlike others, the patented **Watermark** provides accurate readings from 0 to 200 centibars. This covers the entire soil moisture range required in irrigated agriculture, even in the heavier clay soils. They require no water or vacuum gauge and thus are MAINTENANCE FREE. The **Watermark** does not dissolve in the soil like a gypsum block. However, it does include internally installed gypsum which provides some buffering for the effects of salinity levels normally found in irrigated agricultural crops and landscapes. Because they are unaffected by freezing temperatures, **Watermark** sensors do not require removal during the winter months in cold climates. They can be used to automatically record and chart readings with the use of sophisticated data logging devices. In automated irrigation systems, the **Watermark** can be used to control or interrupt irrigation cycles, which are not needed.

WHAT THE READINGS MEAN

The **Watermark** readings reflect soil water tension or suction. The meter internally converts the electrical resistance reading of the sensors to this tension or suction value. This major physical force of soil water is a direct indicator of how hard the plant root system has to work to extract water from the soil. The drier the soil, the higher the reading.

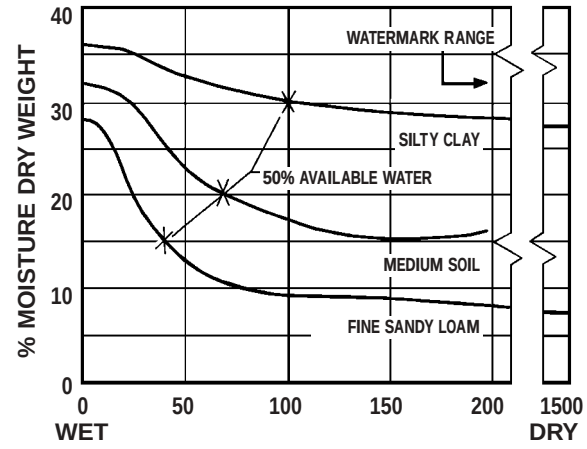
By reading your sensors 2-3 times between irrigations, you will notice the rate at which the soil is drying out. The **"rate of change"** is as important as the actual reading in determining when to irrigate to avoid moisture stress. *(See Figure 2).* Readings are best taken in the morning. The **Watermark** meter has a soil temperature compensation feature. This allows for greater accuracy as electrical resistance readings vary 1% per degree Fahrenheit encountered in the soil. On a day to day basis, this will not have a major effect, but on a seasonal basis (spring vs. summer) it needs to be taken into account.

DETERMINING "WHEN" TO IRRIGATE

Figure 1 shows how variations in soil affect the ability of the soil to store water (water holding capacity). Heavier clay soils store much more water than sandy soils. But even more important, the plant cannot readily extract all of this stored moisture, only the "available" portion. The general rule of thumb is that irrigation should commence before you reach 50% of the "available" portion being depleted. From Figure 1 you can see what the soil moisture tension is at the 50% level of available moisture.

Assuming your soil was of a medium type, this 50% level would occur at about 60-70 centibars. While determination of the proper irrigation point is largely dependent on soil type, you must also consider the crop and your irrigation method. Sensitive crops may require irrigation sooner, less sensitive crops may not need water until later. Surface irrigation may allow you to apply water much more rapidly than a drip system, thus you need to consider how quickly your system can react in order to avoid moisture stress. (*See Figure 2).*

FIGURE 1.



DETERMINING "HOW MUCH" TO IRRIGATE

Your own record keeping system, and experience with your crop, soils and irrigation method are essential with any good management system. With **Watermark** Sensors properly placed in both the top (e.g. 12") and bottom (e.g. 24") of the crop root system, your readings will tell you whether it is the shallow or deep moisture which is depleted. If your shallow reading is 60 and your deep reading is 10, you know you only need to apply enough water to rewet the top 12". If the readings are reversed, with 40 for the shallow and 60 for the deep, you may need to apply twice as much water. The local farm advisor or Soil Conservation Service can be of great help to you in determining your individual soils and how much water they store. This will help you use the **Watermark** Sensor readings to effectively control your irrigation scheduling and to prevent excessive leaching of plant nutrients. *(See Figure 2)*.

FIGURE 2.