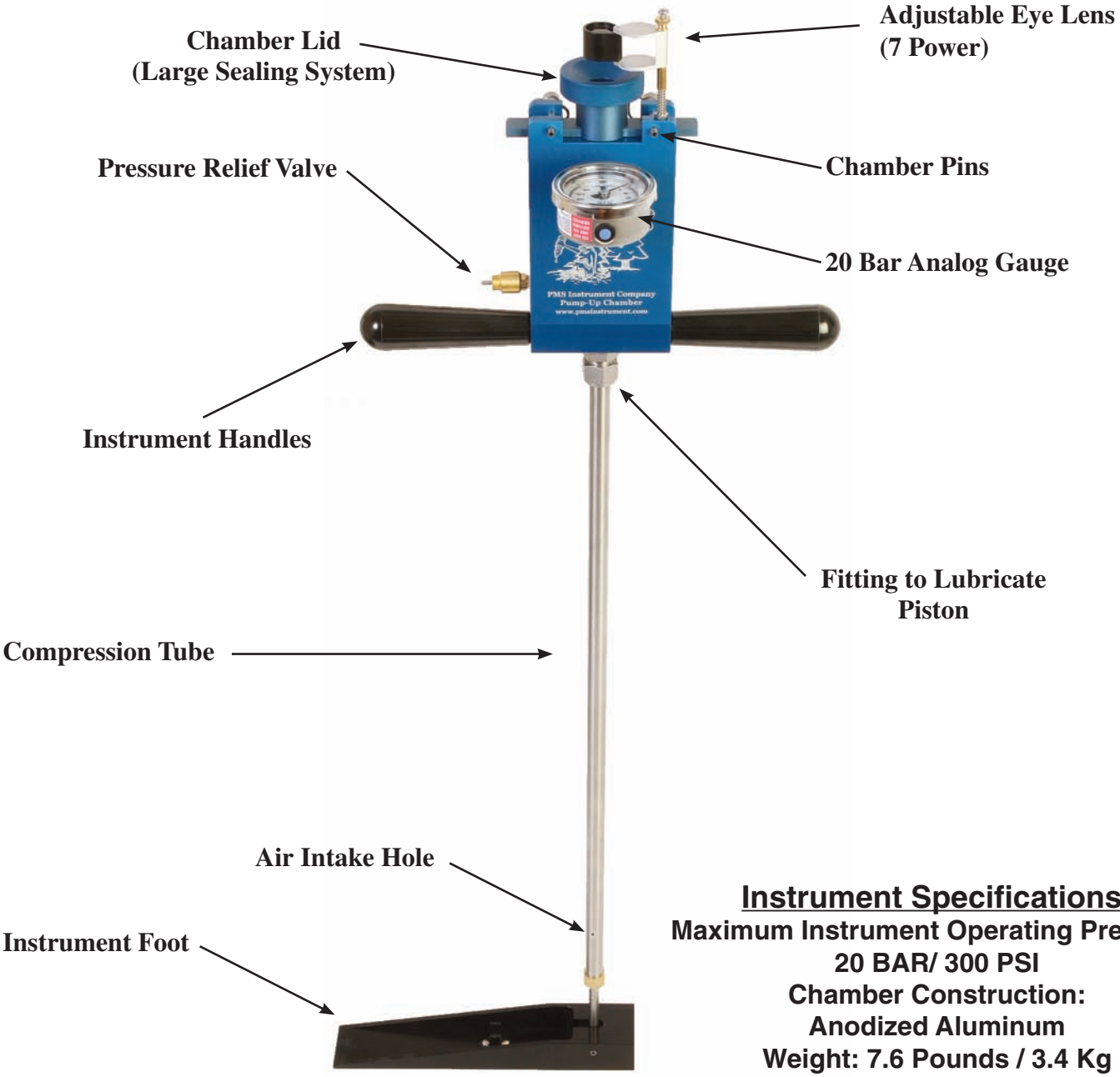
Pump-Up Chamber Instrument

PMS Instrument Company

1725 Geary Street SE ✦ Albany OR 97322 ✦ USA
Phone: (541) 704-2299 ✦ FAX: (541) 704-2388
info@pmsinstrument.com
www.pmsinstrument.com

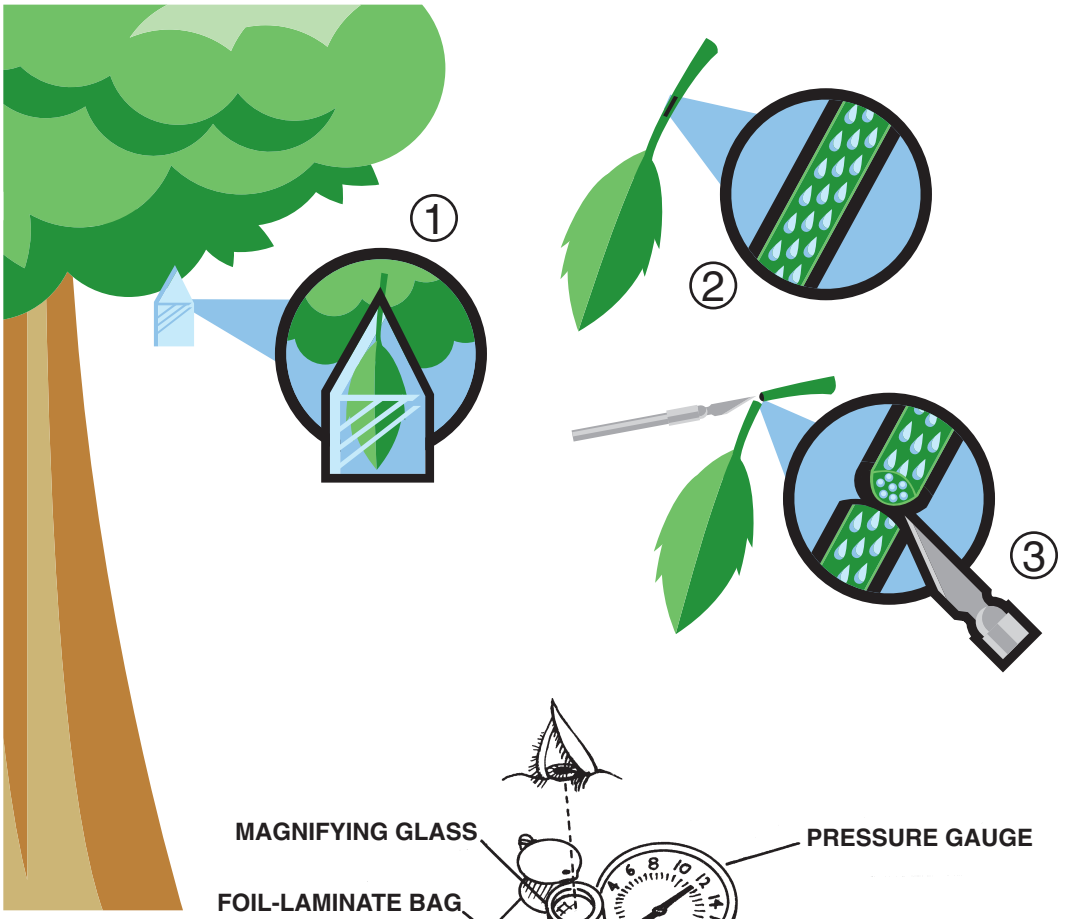
OPERATING INSTRUCTIONS

FOR A COMPLETE LIST OF PICTURE TUTORIALS AND VIDEOS - WWW.PMSINSTRUMENT.COM



Instrument Specifications:

Maximum Instrument Operating Pressure:
20 BAR/ 300 PSI
Chamber Construction:
Anodized Aluminum
Weight: 7.6 Pounds / 3.4 Kg

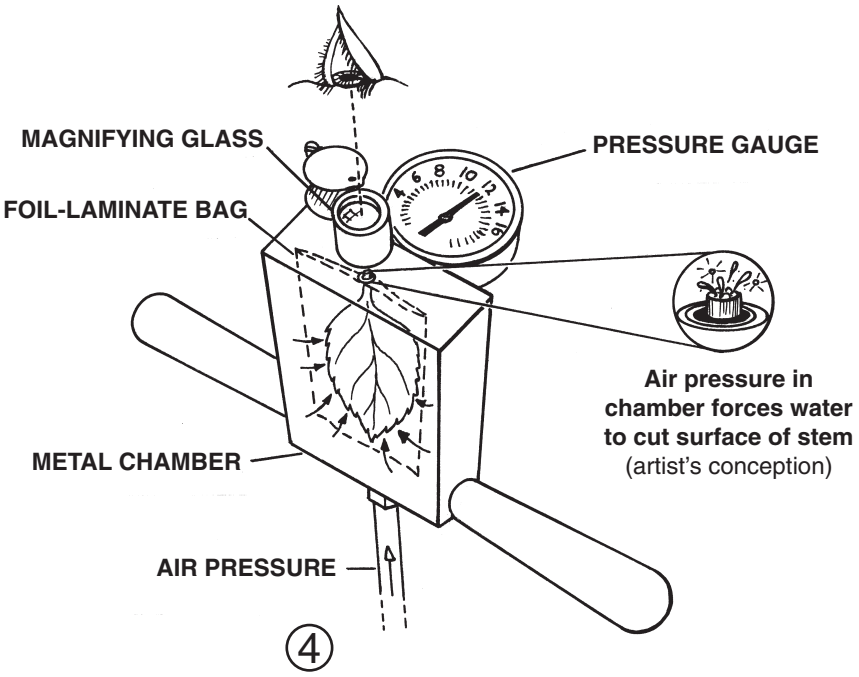


1) A lower canopy, shaded leaf is covered with foil-laminate bag.

2) The water in the stem is under tension.

3) The stem is cut and the leaf with bag is sealed inside chamber.

4) Pressure is applied to the leaf until water appears at the cut surface.



How it Works

Simply put, the pressure chamber is just a device for applying pressure to a leaf or small shoot. Most of the leaf is inside the chamber, but the cut end of the stem (the petiole) is exposed outside the chamber (see illustration above). The amount of pressure it takes to cause water to appear at the cut surface of the petiole tells you how much tension the leaf is experiencing on its water supply. A high value of pressure means a high value of tension and a high degree of water stress. These stress levels vary within different species. The unit of pressure most commonly used is Bar (1 Bar = 14.5 PSI).

What is Plant Moisture Stress?

The water status of plants, and how to measure it, has received much attention in recent years and for good reason. Plant moisture stress (PMS), or plant water potential, indicates the demand for water within a plant. A PMS measurement indicates the water status of a plant from the "plant's point of view." PMS also tells how the environment affects the plant. High PMS levels cause many physiological processes, such as slowing or stopping photosynthesis. Conditions producing high PMS reduce plant growth and may eventually result in the death of the plant. PMS information can be used to evaluate the plants need for water or how well it is adapted to its environment.

Why Measure Plant Moisture Stress?

Measuring PMS gives an indication of a plants ability to grow and function and can be used as a guide for managing the plants moisture environment so as to improve growth and crop yield. Air temperature, wind speed, humidity, and soil moisture are all integrated by the plant into one single value — PMS. A measure of PMS thus gives an evaluation of the moisture status of a plant from the plants point of view. It is an excellent tool for aiding in irrigation scheduling for crop plants such as almond, walnut, prunes, cotton, and wine grapes or for any application where plant growth is managed such as in nurseries, greenhouses, seedlings or reforestation.

Principle of Operation

The pressure chamber can be thought of as measuring the "blood pressure" of the plant — except that for plants it is water rather than blood. And the water is not pumped by a heart using pressure, but rather pulled with a suction force as water evaporates from the leaves. Water within the plant mainly moves through very small inter-connected cells, collectively called xylem, which are essentially a network of pipes carrying water from the roots to the leaves. The water in the xylem is under tension. As the soil dries or humidity, wind or heat load increases, it becomes increasingly difficult for the roots to keep pace with evaporation from the leaves. This causes the tension to increase. Under these conditions you could say that the plant begins to experience "high blood pressure."

Since tension is measured, negative values are typically reported. An easy way to remember this is to think of water stress as a "deficit." The more the stress the more the plant is experiencing a deficit of water. The scientific name given to this deficit is the "water potential" of the plant. The actual physics of how the water moves from the leaf is more complex than just "squeezing" water out of a leaf, or just bringing water back to where it was when the leaf was cut. However, in practice, the only important factor is for the operator to recognize when water just begins to appear at the cut end of the petiole.

The Plant Moisture Stress (PMS) reading at any given time reflects the plant's interaction with the water supply and the demand for water placed upon the plant by its environment (see diagram on back cover). Since these factors are almost always changing, PMS is nearly always changing. The time of measurement therefore requires careful consideration — PMS is most at midday and least just before sunrise. Pre-sunrise PMS values will usually reflect average soil moisture tension, if the soil is uniformly irrigated. Midday PMS values reflect the tension experienced by the plant as it pulls water from the soil to satisfy the water demand of the atmosphere.

GETTING STARTED

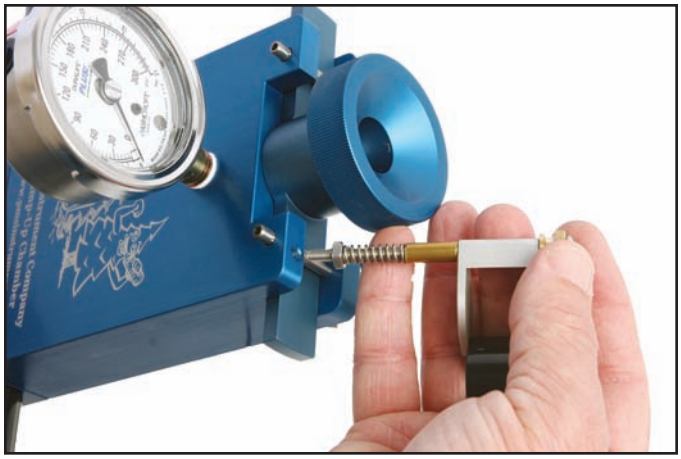
1. Install the handles. The instrument is normally shipped without the handles for a more compact shipment.

2. The instrument comes complete with a sample packet of thread locker (Loctite 242) and the two handles.

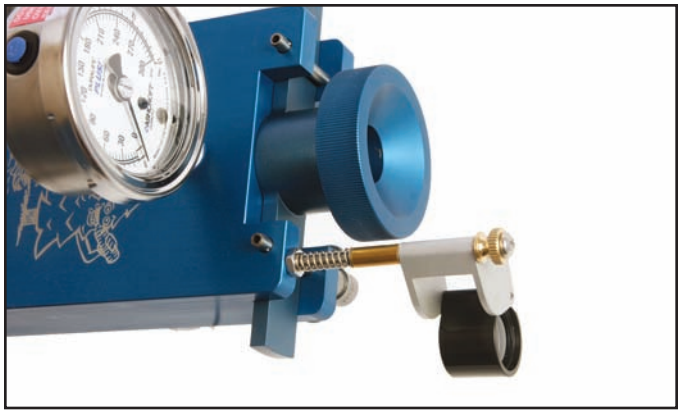
3. Break the lid from the thread locker and apply a liberal amount to the threads of the handle. Screw handles into Chamber Base hand tight.

EYE LENS INSTALLATION

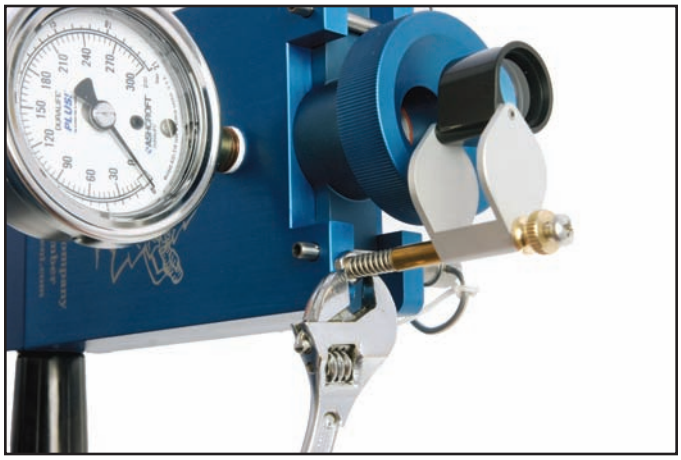
1. Locate the Eye Lens mounting hole a the top of the chamber. If you have different styles of lids, ensure you have the correct mounting screw. Large and Grass lid both use a brass spacer above the spring. Small Lid requires no spacer.



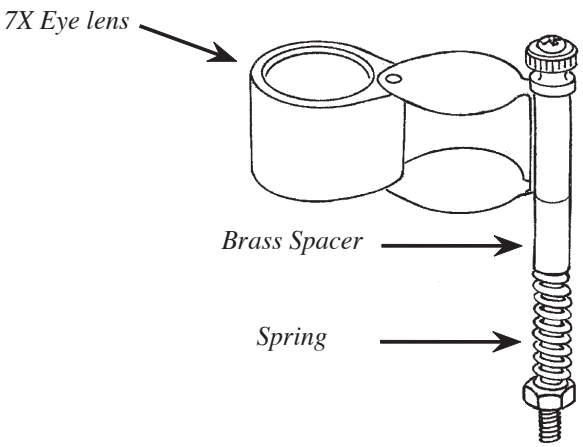
2. Screw into the mounting hole until the nut touches the chamber.



3. Use a wrench to tighten the nut into place so the Eye Lens is secure.



4. Use the knurled brass nut to adjust the focal point of the lens appropriate for your vision.

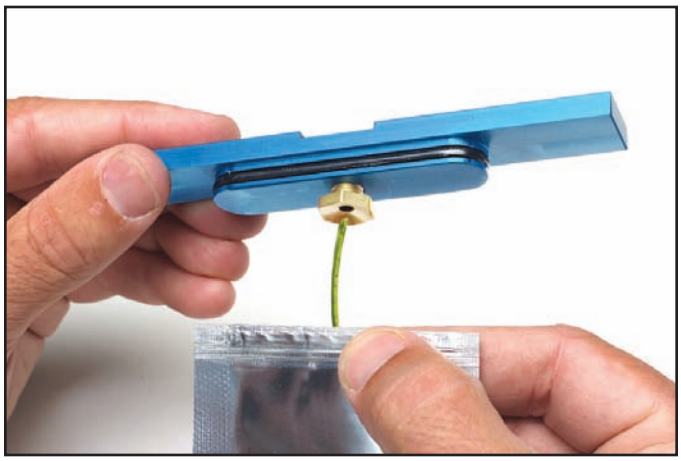


TAKING THE MEASUREMENT

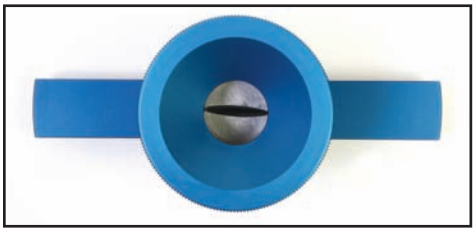
1. Cut a leaf from the plant to be tested.

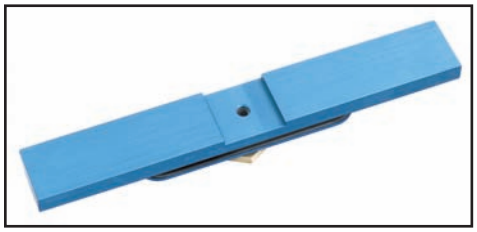
2. Remove the Chamber Pins (Pins have push-button quick releases).

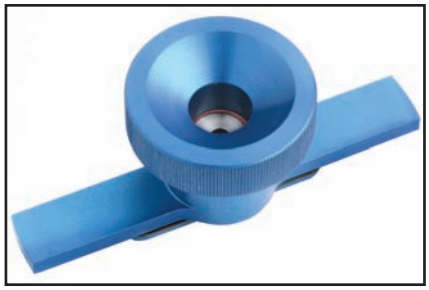
3. Remove the Chamber Lid. Insert stem through hole in center of lid so that the end barely protrudes.



4. Turn Compression Gland Screw clockwise to tighten the gasket around the sample. This depends upon which lid is being used. With the Small Lid, the Compression Gland Screw is made of brass and is on the inside edge of the lid. The Large and Grass lid have an anodized blue Compression Gland Screw that is external.



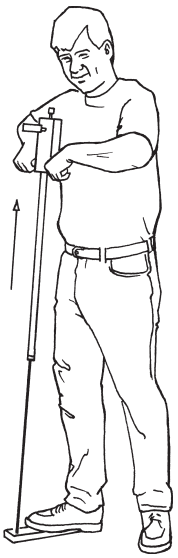




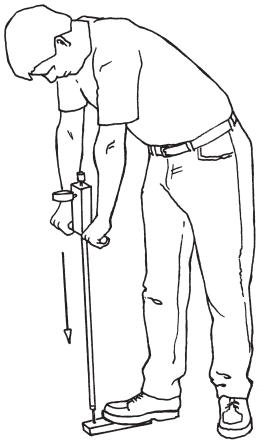
5. Put leaf inside chamber and lock down the lid into chamber. Place Chamber Pins completely through holes so they are in locked position.

6. Ensure you are wearing eye protection in case sample slips out of chamber. Place foot on foot-rest, swing eye lens in place and adjust as needed.

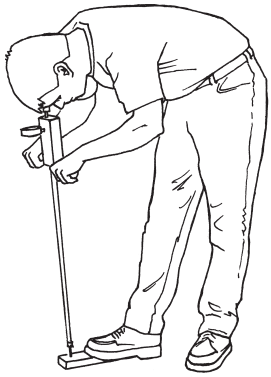
7. Begin pumping the chamber by grasping handles and lifting chamber completely to the stop, then pushing down to the stop. Each cycle will increase pressure by about 1/2 Bar or 7 PSI. While pumping on the down stroke, watch sample through eye lens for a film of water to appear. When water appears, stop pumping and record pressure indicated on gauge.



INTAKE STROKE
Lift up instrument to take in air



COMPRESSION STROKE
Push down instrument to compress air into chamber

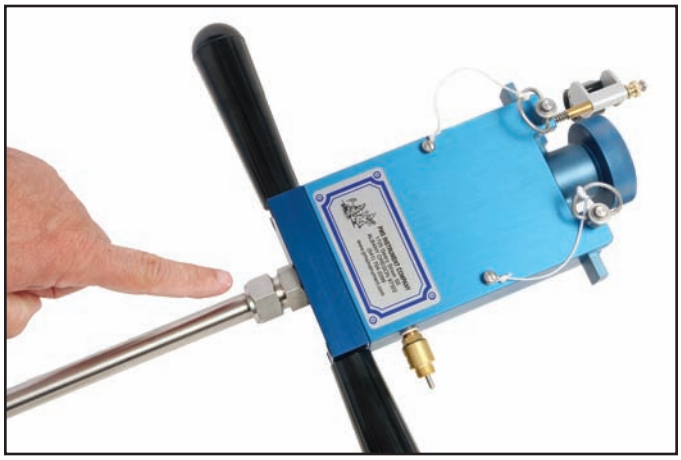


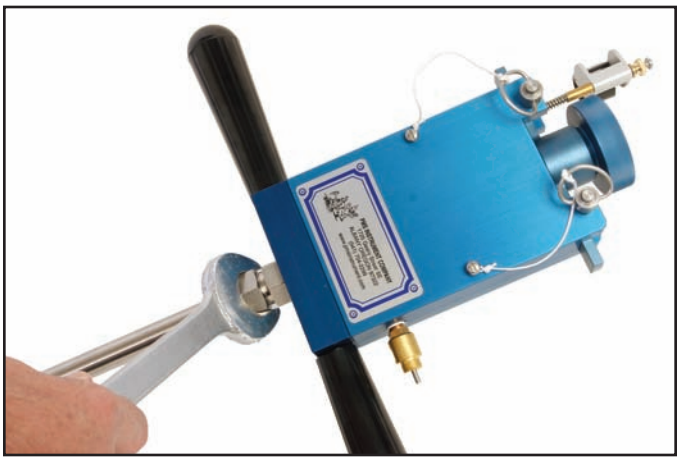
CHECK
Look to see if water has come to surface of cut stem

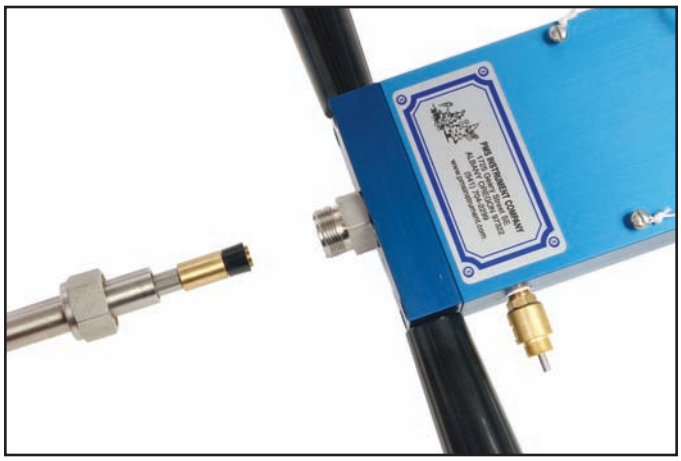
8. Use Pressure Relief Valve to release the pressure completely, remove pins and lid and you are now ready to measure another sample.

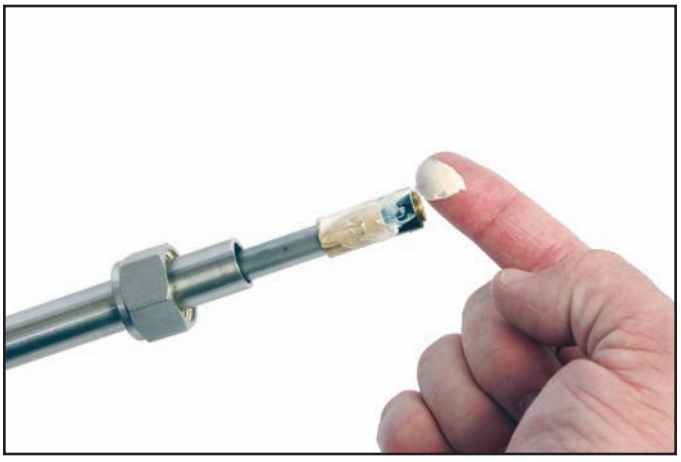
INSTRUMENT MAINTENANCE

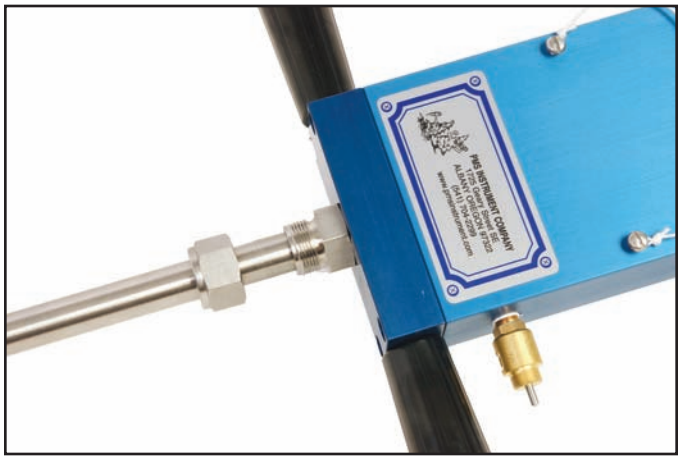
1. For optimal performance lubricate the O-Ring around the lid with Petroleum Jelly each trip to the field. If the O-Ring becomes dirty, remove the O-Ring from the lid. Clean with rag and lubricate with Petroleum Jelly.
2. The piston should be lubricated occasionally for optimal performance. Use a lithium based lubricant such as “White Grease”. Loosen the fitting at the base of the instrument to release the Piston Tube. Cycle the Piston out of the tube and clean with a rag. Lubricate with lithium based grease. Cycle the piston up and down through the Compression Tube to distribute the grease. Piston rod should not be lubricated. When finished, push piston down into Compression Tube, clean the end of the tube and slide tube back into fitting. Ensure that the Compression Tube is completely all the way back inside and resting at the base of the chamber. Slide the ferrules and nut back into place and hand tighten. Use a wrench to tighten only about 1/6 of a turn (1 flat). DO NOT overtighten this fitting as it will deform the Compression Tube.



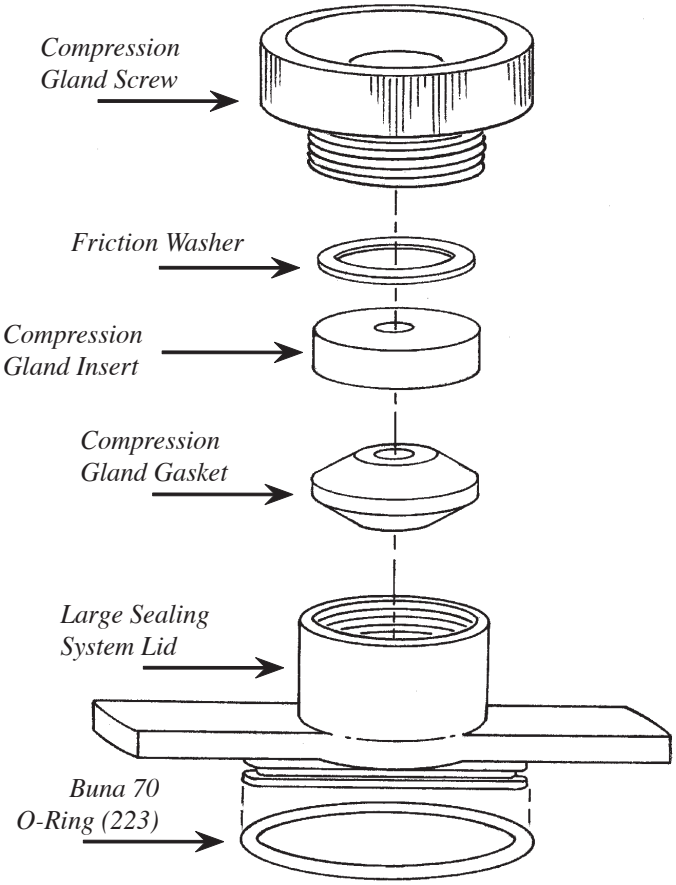




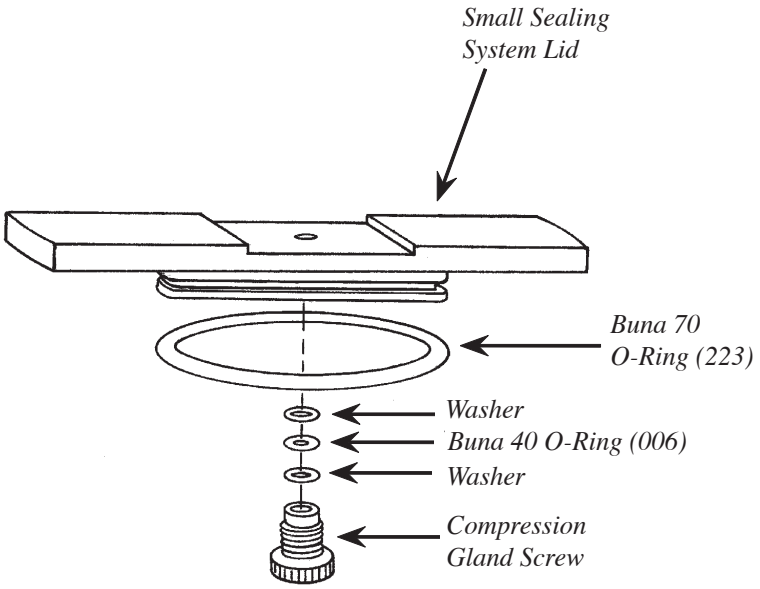




3. If Pressure Relief Valve becomes obstructed with dirt or plant debris, clear this by blowing compressed air in reverse through the valve. Cycle the valve several times while blowing air. This should clear any obstruction.



4. Compression Gland Gasket or Grass Compression Gland Gasket may become worn and in need of replacement. Replace as noted in exploded view at left.



5. Small Sealing Lid comes with a variety of size 006 Buna 40 O-Ring and metal washers. These can be changed to accommodate different plant samples or replaced when worn.

Warnings, Considerations and Limits

Intended Usage

The Pressure Chamber Instrument usage is intended for applying pressure to plant material to determine water potential or to extract water xylem from plants. It should not be used to pressurize anything other than plant material. Using this instrument for any other purpose or in an unsafe manner could result in harm to the user.

Upon receiving the instrument or using it for the first time, each user should familiarize themselves thoroughly with all safety features and set-up process to avoid damage of instrument or physical injury to operator.

Working Environment

The instrument is robust and durable and designed for outdoor use. It may be used in temperatures as high as 55º C and as low as –10º C. It is best to store inside where temperatures do not exceed 40º C or lower than 0º C. Keep in clean and dry area. Store on a flat surface that is protected from being struck or damaged. Normal vibration during use will not affect performance of the instrument such as travel in vehicle or all terrain vehicles. Excessive shaking and vibration can cause damage. If the instrument has received a hard blow or hit, it should be evaluated prior to further use. The instrument is not vulnerable to humidity but should never be submersed in water. If the instrument becomes submersed, allow it to dry and evaluate the instrument prior to further use.

Transporting Instrument

Transporting the instrument by any mode should be done with care as not to strike the instrument against anything hard as this might damage the instrument. If transporting by vehicle such as truck, car or all terrain vehicle; the instrument should be securely fastened in order to avoid any damage to the instrument.

Maintenance

Most maintenance issues can be done without much training. Consult the maintenance pages in this manual. However, any adjustments to piping or high pressure connectors should only be performed by factory or authorized personnel. Consult us directly for more information.

Disposal or Decommission of the Instrument

While the instrument should provide years of use, it is possible that sometime it will be disposed of. Local recycling guidelines should be followed for disposal.

PMS Instrument Company

1725 Geary Street SE ✦ Albany OR 97322
Phone: (541) 704-2299
FAX: (541) 704-2388
E-mail: info@pmsinstrument.com
www.pmsinstrument.com

EU
Declaration of Conformity

We,

PMS Instrument Company
1725 Geary Street SE
Albany, OR 97322 USA

Declare under our sole responsibility that the following products:

Pump-Up Chamber, 600 Pressure Chamber, 605 Pressure Chamber, 615 Pressure Chamber, 615D Pressure Chamber, 1000 Pressure Chamber, 1005 Pressure Chamber, 1000 "upgraded to 100 Bar" Pressure Chamber, 1005 "upgraded to 100 Bar" Pressure Chamber.

In addition, the following accessories are included:

Cavitation Chamber

To which this declaration relates is in conformity with the following Standards or other normative documents:

EN ISO 12100-1:2003, EN ISO 12100-2:2003, 97/37/EC Annex I

Following the provisions of Directives;

98/37/EC, 97/37/EC (Equipment is below class I limits per the PED)

SOLS MESURES
17, rue Jean Monnet - BP 44
78990 ELANCOURT - FRANCE
Tel. 01 30 50 34 50 - Fax 01 30 50 34 49
info@sols-mesures.com
www.sols-mesures.com

Responsible party in the European Union: _____

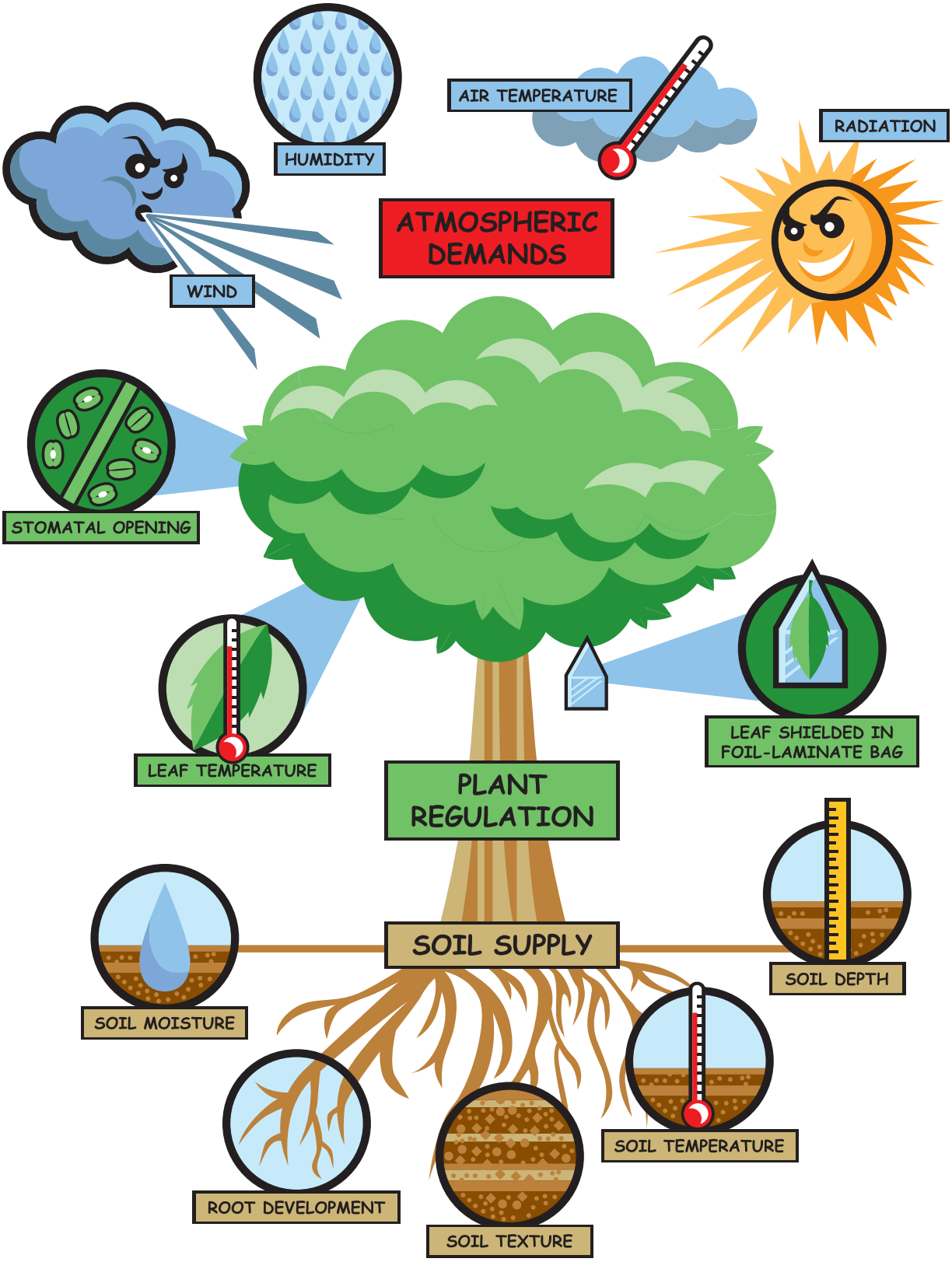
Officer: Jean-Luc AVERLAN
Sols Mesures

Place: Elancourt, France
Date: May 6, 2009

President, PMS Instrument Company: _____

Officer: Jeff Hamel, President
PMS Instrument Company

Place: Albany, Oregon, USA
Date: May 6, 2009



Atmospheric Demands: The atmosphere of the plant puts four different demands on the plant: wind, humidity, air temperature, and radiation.

Plant Regulation: The plant regulates water stress by opening and closing the stomata (small holes) on the backside of the leaf. Other regulators used are leaf flagging, rolling and leaf loss. Good root development is also key in regulating water stress.

Soil Supply: Soil composition is critical for the plant. Moisture content is a key factor in PMS. In addition, the temperature of the soil and depth will influence PMS. Depending upon the texture of the soil and how it holds moisture is another important aspect of the soil. Loose sandy soil will drain out moisture quickly while heavy clay will hold moisture longer.