PUMP-UP
PRESSURE CHAMBER INSTRUMENT

Effective Date: November 2019

OPERATING INSTRUCTIONS

Read Operating Instructions before using this instrument. Failure to do so can result in serious injury or death.

Instrument Specifications:

Maximum Instrument Operating Pressure:
20 BAR/ 300 PSI

Chambers Construction:
Anodized Aluminum

Weight:
7.6 Pounds / 3.4 Kg

FOR A COMPLETE LIST OF PICTURE TUTORIALS AND VIDEOS VISIT US ONLINE AT:

WWW.PMSINSTRUMENT.COM

IMPORTANT SAFETY INFORMATION

Read all instructions contained in these Operating Instru
Keep these instructions with the Pressure Chamber Instru

General Warnings

- Safety Glasses must be worn at all times when preparing the Pressure Chamber Instrument for use and using the Pressure Chamber Instrument.
- Working with pressurized air requires safe handling. Precaution and safety measures must be followed.
- Gas fittings and valves can fail. Safety measures must be followed to ensure that in the event of an accidental failure of any equipment the user will not be injured. Possible consequences of failure include but are not limited to:

a. Couplings or parts thrown off at high speed. Could cause bodily injury or even death.

b. High pressure discharge of gas. Could penetrate skin and cause bodily injury.

Appropriate and Intended Use

- The Pressure Chamber Instrument must only be used for the purpose it was intended; that intended purpose is to pressurize plant samples in order to measure xylem water potential, extract xylem water or induce cavitation into plant samples. Any other process or use is not recommended and user could be injured or even killed.

Working Environment

- Whenever operating the Pressure Chamber Instrument, be sure to operate in a safe environment. Locate the instrument foot on a flat surface when operating.
- The Pressure Chamber Instrument should be operated and stored in temperatures no lower than 20 degrees Fahrenheit / -7 Celsius and maximum temperature of 120 degrees Fahrenheit / 49 Celsius. Outside of this range could cause damage to instrument.

Testing a Leaf

(Pressurization of a Sample)

- Instrument should be prepared properly to work with the samples being tested.
- Always fit the appropriate sized insert with appropriate sized gasket to ensure the sample does not extrude or shoot out of the lid.
- Safety Glasses must be put on prior to pressurizing the instrument; they should be worn for the duration of the test until the instrument is fully depressurized and put away.

ctions before use to avoid serious injury or death.
ument at all times.

- When viewing a sample, ensure your eyes are not directly over the sample. View from a slight angle. This will ensure your eyes are not over the sample if it accidentally extrudes or shoots out of the chamber lid.
- If sample appears to move during pressurization, stop the process and ensure it is properly sealed and that you are using the best possible gasket, insert or lid for this sample.
- If you cannot get a good seal on the sample, discontinue testing.

Transporting Instrument

- Never transport the Pressure Chamber Instrument while pressurized. Chamber should be completely depressurized.

Damaged Instrument

- In the event the instrument is dropped, struck or damaged it should be returned to PMS Instrument Company for evaluation prior to further use. Using damaged equipment could result in physical injury or death!
- Each instrument should be inspected on regular intervals depending upon usage but at least annually. High Pressure Fittings and instrument should be inspected for wear, cracks, leaks or any other damage that might cause danger to the user. Instrument should be in good working order prior to use! Failure to correct these problems can lead to injury or death!

Other Warnings and Considerations

- These are basic guidelines and safety recommendations. User must consult and comply with local laws that might further govern the use of the instrument or use of compressed gases.

Disposal or Decommission of the Instrument

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

How The Pressure Chamber Works...

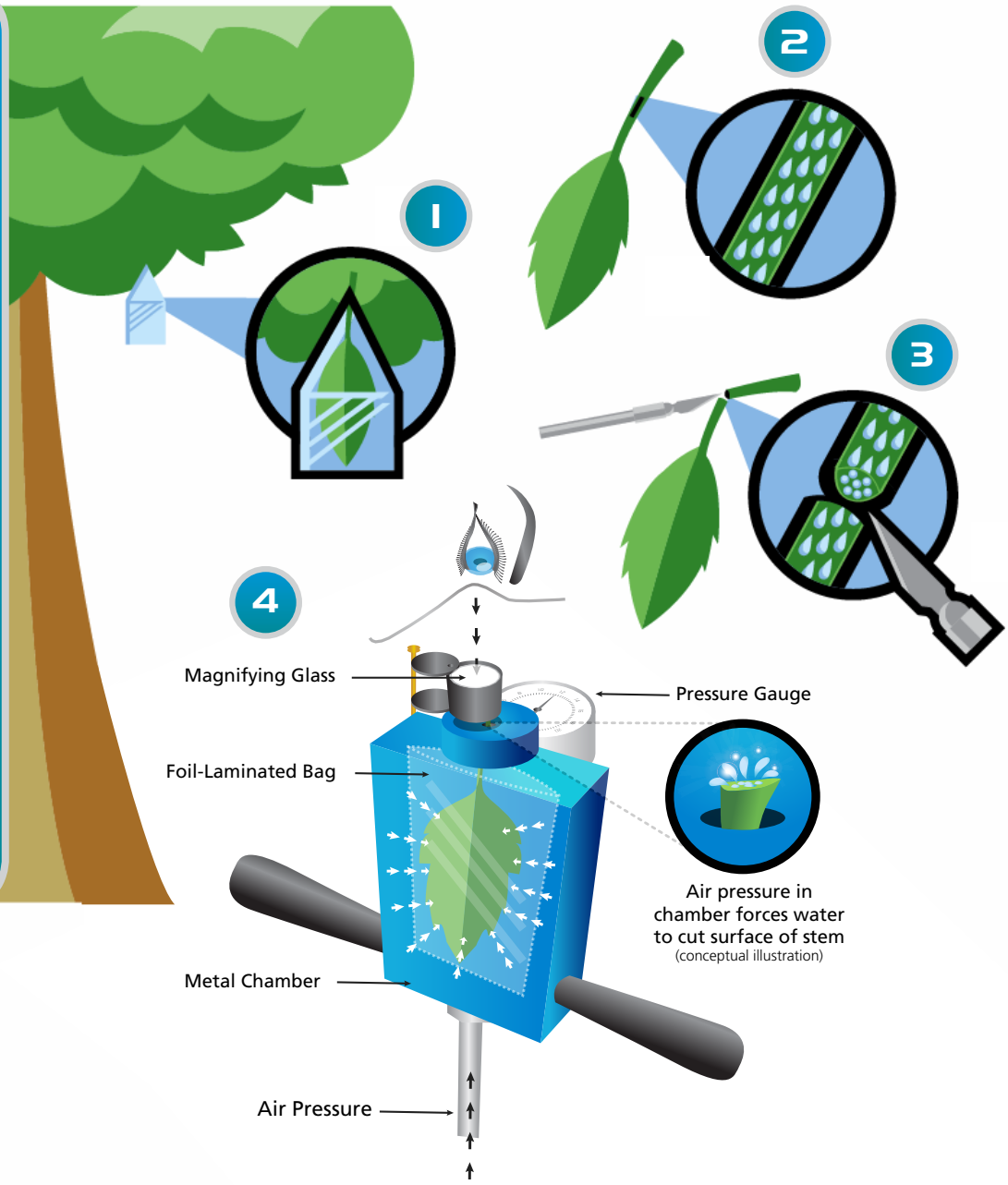
Simply put, the pressure chamber is just a device for applying pressure to a leaf or small shoot. Most of the leaf is inside the chamber, but the cut end of the stem (the petiole) is exposed outside the chamber *(see illustration below)*. The amount of pressure it takes to cause water to appear at the 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).

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.



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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 *Installing the Handles.*

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

Step 1) The instrument comes complete with a small sample of thread locker (Loctite 242), and the two instrument handles.

Step 2) Loctite 242 will lock the handles in place, but still allow you to remove them if necessary.

Step 3) Grasp the cap of the Loctite sample and break it off and twist at the same time.

Step 4) Apply a liberal amount of the Loctite 242 thread locker to the threads of the handle.

Step 5) Screw the handle into the base of the Pump-Up Chamber Instrument.

Step 6) Install the second handle. Lastly, grasp both handles and firmly twist them into place. The threadlocker should reach it's full strength within 24 hours.

EYE LENS INSTALLATION

Step 1) The Large Sealing Lid and the Grass Sealing Lid come with an eye lens like the one above.

Step 2) The Small Sealing Lid will look like this.

Step 3) Locate the Eye Lens mounting hole on the Pressure Chamber. Screw it in until the nut touches the chamber.

Step 4) Use a wrench to fix the nut firmly so the Eye Lens does not slip or come out of the hole.

Step 5) When finished the Eye Lens should look like this.

Step 6) The focus of the Eye Lens can be changed by tightening down the brass thumb nut while looking through the eye lens.

MAKING THE MEASUREMENT

Secure the sample

Step 1) Insert the cut end of the petiole (stem) through the hole from the bottom side of the chamber lid.

Step 2) Petiole should barely protrude through the lid.

Step 3) Twist the Compression Gland Screw till the sample is fixed firmly in the lid. The Large Chamber lid is demonstrated in the picture.

Note: The Small Lid will have a brass Compression Gland Screw on the underside of the lid.

Step 4) Put the leaf into the chamber.

Step 5) Fix the Chamber pins properly in place.

PRESSURIZING THE CHAMBER

Step 1) With one of your feet firmly planted onto the Pump-Up Chamber Foot, grasp the two handles of the instrument and lift up. This requires a minimal effort and should not be done with extreme force or the piston inside the instrument can be damaged.

Step 2) Push down on the chamber. As you are doing this, ambient air is being compressed into the chamber. Push down completely. This should increase the pressure in the chamber by about ½ bar or 7 psi per stroke.

Step 3) View the sample through the Eye Lens and watch for water to come out.

Step 4) Continue pumping. If you know approximately what the value for the plant is, you can pump to within 10-20% of the assumed value, check the leaf and then continue slowly 1 stroke at a time till you reach the end-point for the leaf.

Step 5) Once you have established the end point you can record the data.

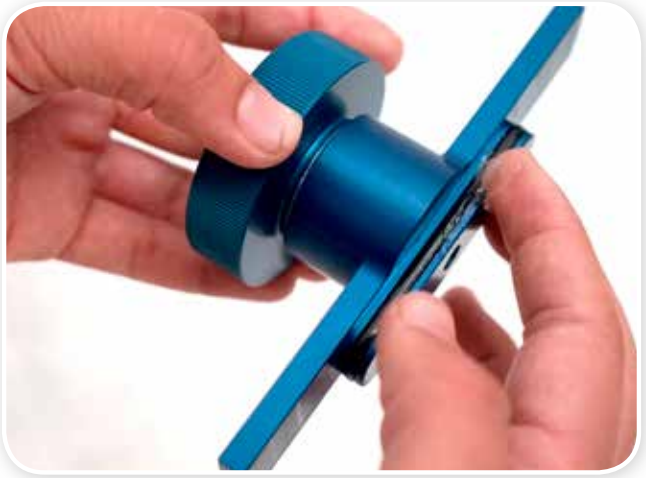
Step 6) Push in firmly on the Pressure Relief Valve to release the pressure from the chamber. *See Image to Left.*

Step 7) The sample can now be removed and discarded.

SECTION 1: MAINTENANCE

LUBRICATING THE O-RING OF THE LID

For optimal performance lubricate the O-Ring around the lid with Petroleum Jelly frequently. This can be done before each trip into the field. If the O-Ring becomes dirty, remove it from the lid. Clean with a rag and lubricate it with Petroleum Jelly.



SECTION 2: MAINTENANCE

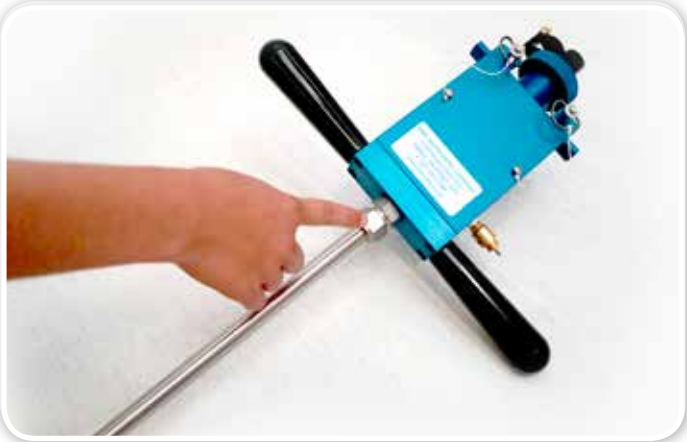
PRESSURE RELIEVE VALVE OBSTRUCTION

If the Pressure Relief Valve leaks or becomes obstructed with dirt or plant debris you can clear this by blowing compressed air in reverse through the valve. Cycle the valve several times while blowing air in reverse through the valve. Be sure there is no sample in the chamber or at least remove the chamber lid when doing this to ensure it properly clears.

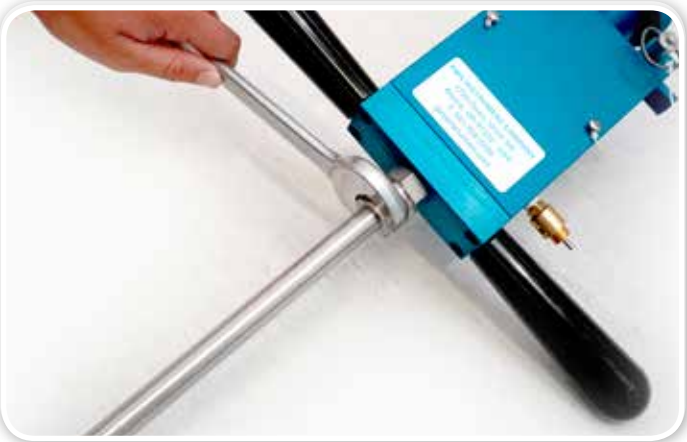
SECTION 3: MAINTENANCE CONT.

LUBRICATING THE PISTON

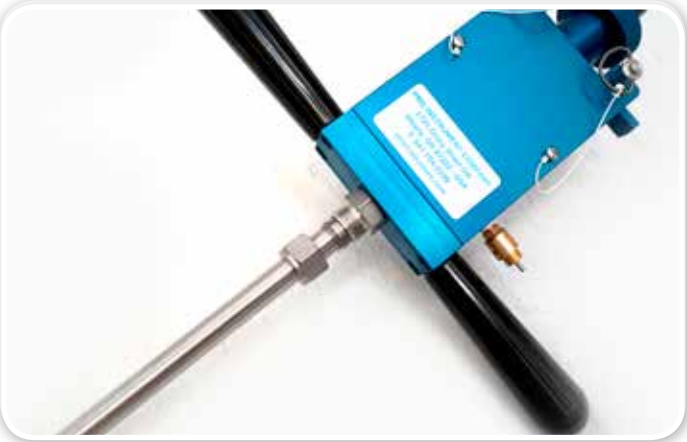
The piston should be lubricated occasionally for optimal performance.
Use a lithium based lubricant such as "White Grease"



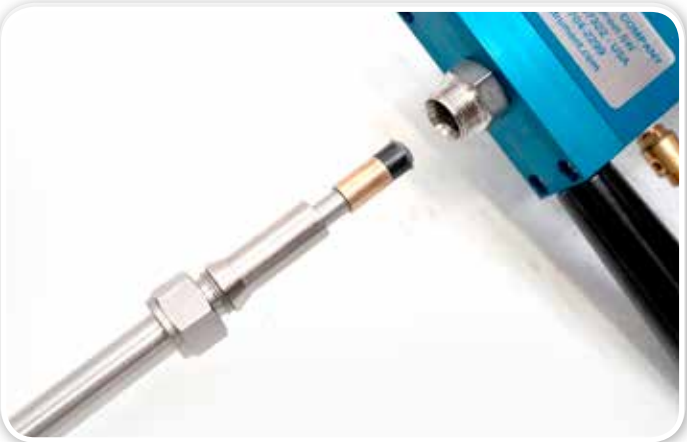
Step 1) Loosen the fitting at the base of the instrument to release the Piston Tube.



Step 2) Use a 1 inch wrench or crescent wrench.



Step 3) Slide the Piston Tube out of the fitting. Observe orientation of the ferrules and nut.



Step 4) Cycle the piston out of the Piston Tube. Wipe clean with a rag.

SECTION 3: LUBRICATING THE PISTON CONT.

Step 4) Check to ensure Piston Cup is in good working order. Lubricate liberally with White Lithium Grease. Cycle the piston several times and re-apply more grease

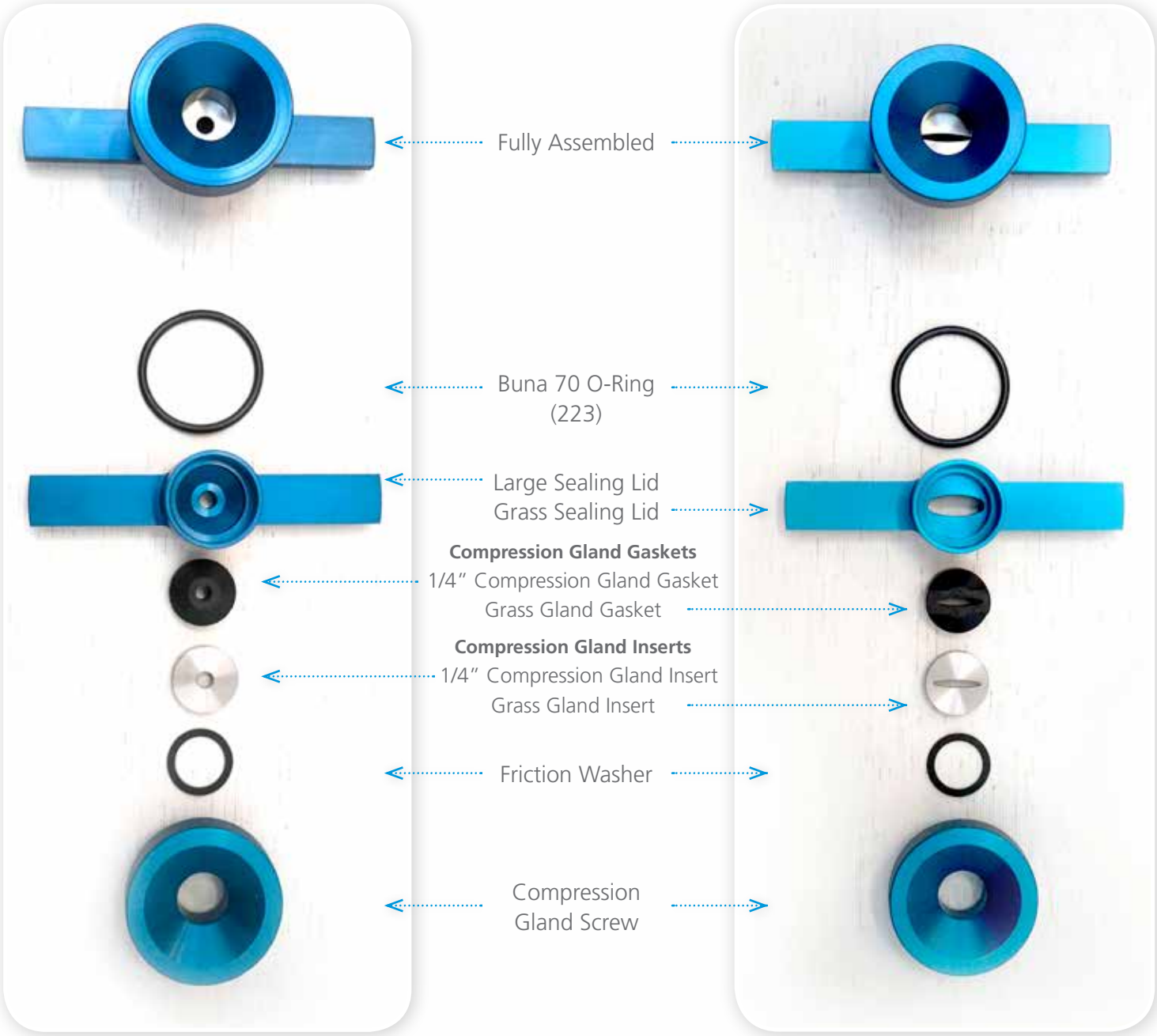
Step 5) Ensure ferrules and nut are orientated properly.

Ensure Piston Tube is completely inserted into the fitting. Slide nut and ferrules forward and tighten nut finger tight. Use a 1 inch wrench to tighten ONLY TIGHTEN 1 FLAT OF THE NUT (1/6 OF A TURN). Over-tightening this nut will cause the Piston Tube to be damaged.

SECTION 4:

SMALL LID ASSEMBLY SEQUENCE

SECTION 4: LARGE LID AND GRASS LID ASSEMBLY SEQUENCE



SECTION 5: PARTS OVERVIEW

1. Chamber Lid
   (Large Sealing System)
2. Pressure Relief Valve
3. Instrument Handles
4. Compression Tube
5. Air intake Hole
6. Instrument Foot
7. Adjustable Eye Lens
   (7X-Power)
8. Chamber Pins
9. 20 Bar Analog Gauge
10. Fitting to Lubricate Piston
11. Foot Keeper Clip

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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, 600D Pressure Chamber,
615 Pressure Chamber, 615D Pressure Chamber, 1000 Pressure Chamber,
1505D Pressure Chamber, 1515D Pressure Chamber, 1505D-EXP Pressure Chamber,

In addition, the following accessories are included:
Digital 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)

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Responsible party in the European Union: _____

Place: Trappes, France
Date: October 2, 2018

Officer: Alexis AVERLAN, CEO
Sols Mesures

President, PMS Instrument Company: _____

Place: Albany, Oregon, USA
Date: October 2, 2018

Officer: Jeff Hamel, President
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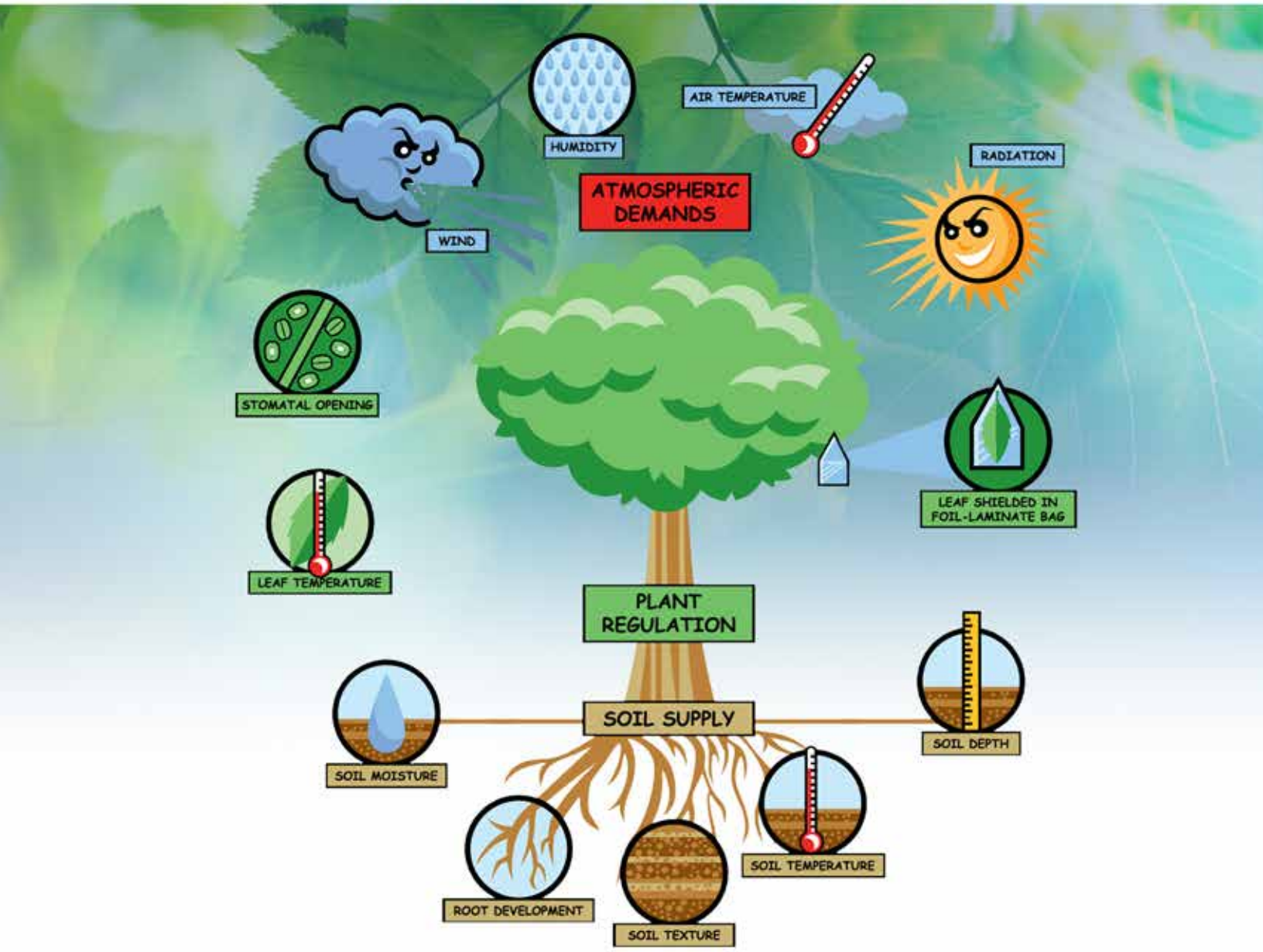
PLANT REGULATION CYCLE:



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.