APS Chamber
User Manual

L.MAN-APSChamber
Manual issue 7 6/05/25 Software issue 1.0 onwards

CAUTION

The chamber has moving parts which could cause injury.
Keep fingers away from moving parts when power is applied.

Contents

Description

The APS is an awkward shape to safely ship without careful packing. It is shipped from ADC in bespoke packaging which the user is encouraged to retain in case it needs to be shipped again.

The APS (Automatic Photosynthesis System) chamber comprises two hinged ‘jaws’ that automatically close onto a leaf to measure the photosynthetic rate. The upper jaw has a replaceable window made from 1mm thick hard faced polycarbonate. It is also fitted with an air temperature sensor. The lower jaw has an infra-red leaf temperature sensor. Both jaws have sponge rubber gaskets to seal onto the leaf so that leaks do not cause measurement errors. The chamber is an ‘open’ configuration system which is tolerant to leaks.

The leaf is held in position by leaf guides so that the jaws close onto it in a reliable and repeatable way. One of the leaf guides has a PAR sensor for measuring incident Photosynthetically Active Radiation.

The jaws hinge on a block which includes a circulation fan which stirs the air in the upper and lower jaws and also circulates it between them through the hollow hinge shafts. This ensures that there in air exchange between the two jaws even when the leaf entirely covers the gasket area.

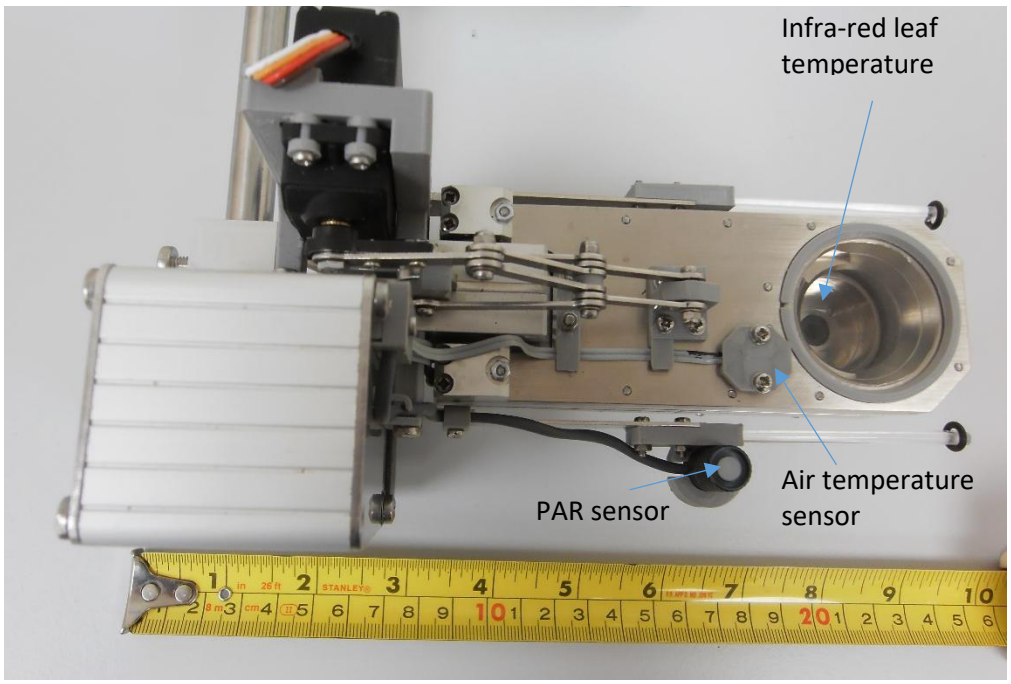
The block has two air connections, the lower one with the white sleeve for ‘analysis’ air out of the chamber and the upper one with the black sleeve for fresh air in. It also has two humidity sensors, to measure the incoming air and the circulating air.

There is an infra-red leaf temperature sensor in the lower jaw which measure the leaf temperature, and a chamber air temperature sensor in the top jaw. The PAR illumination level is measured by a wire-ended sensor which clips into a holder next to the leaf support arm.

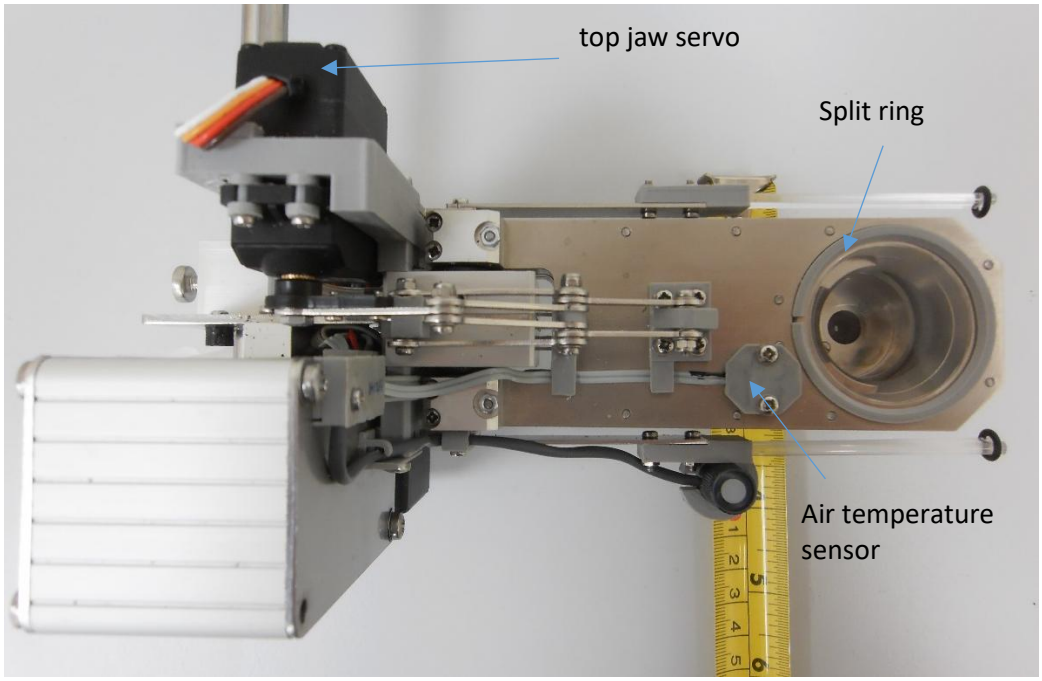
All the sensors are connected to a microprocessor board in the control box. This will communicate with the main controller with RS485 protocol. There is a small red ‘reset’ button on the back panel of the box and two red LEDs. The lower one next to the reset button shows that power is applied, and the upper one is a status indicator.

The jaws are electrically operated by servos, one for each jaw. The servos have positional feedback so that their position can be monitored by the microprocessor. The servos are powerful: keep your fingers away from moving parts when power is applied, particularly avoid the linkage.

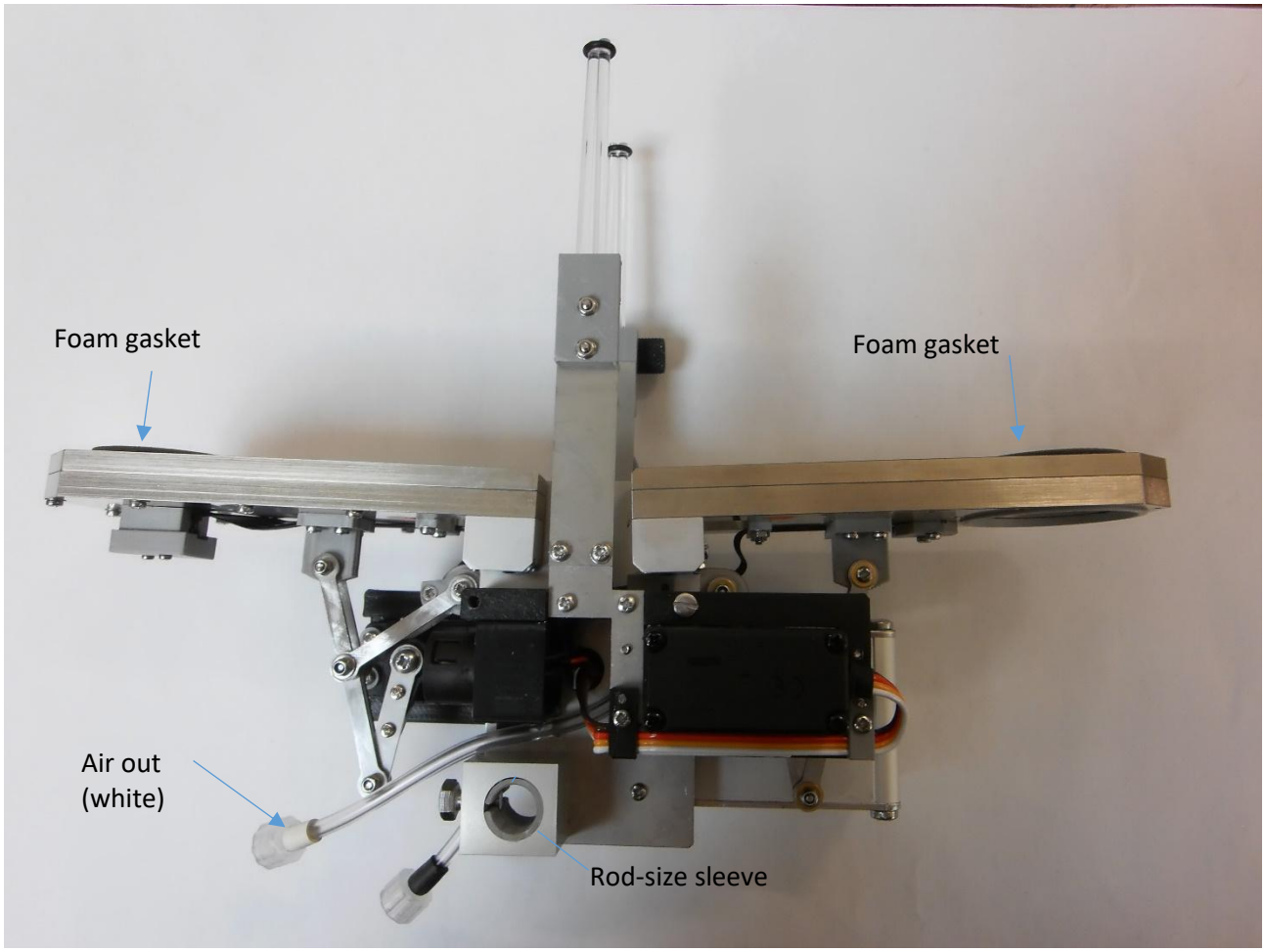
The jaw gaskets are relatively soft to give a good seal on leaves without needing excessive clamping pressure. A consequence of this is that the gaskets can suffer from ‘compression set’ when they are left for many hours in a compressed state. To avoid this problem in storage or transportation, the chambers are supplied with a soft black rubber clip which fits on the front of the lower jaw and holds the jaws sufficiently apart that the gaskets do not touch. Be sure to remove this clip before normal operation, and for fan screw it if the chamber is to be stored with the jaws nominally closed (which is the recommended position to minimise the possibility of damage of ingress of debris).



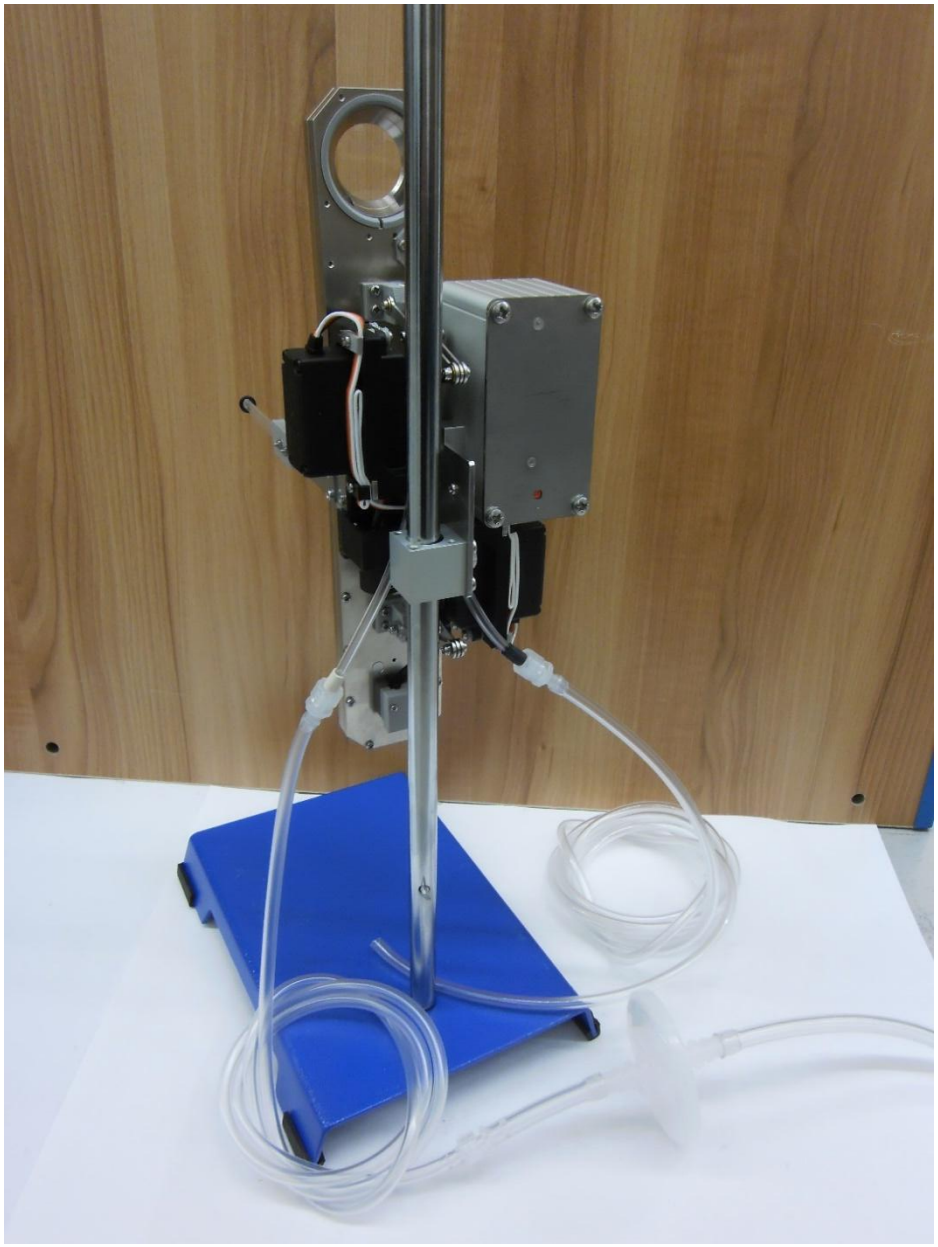
The APS chamber is 20 cm long overall.



And is 10cm wide.
A protective cover is supplied, which, when fitted, increases the width to 10.4cm.
Note the split ring in the picture above, which can be removed to allow replacement of the window.



The chamber is 27cm between jaw tips when open.
Note the replaceable self-adhesive foam gaskets APS106, available as spares, and the removable sleeve for different main support rod sizes.



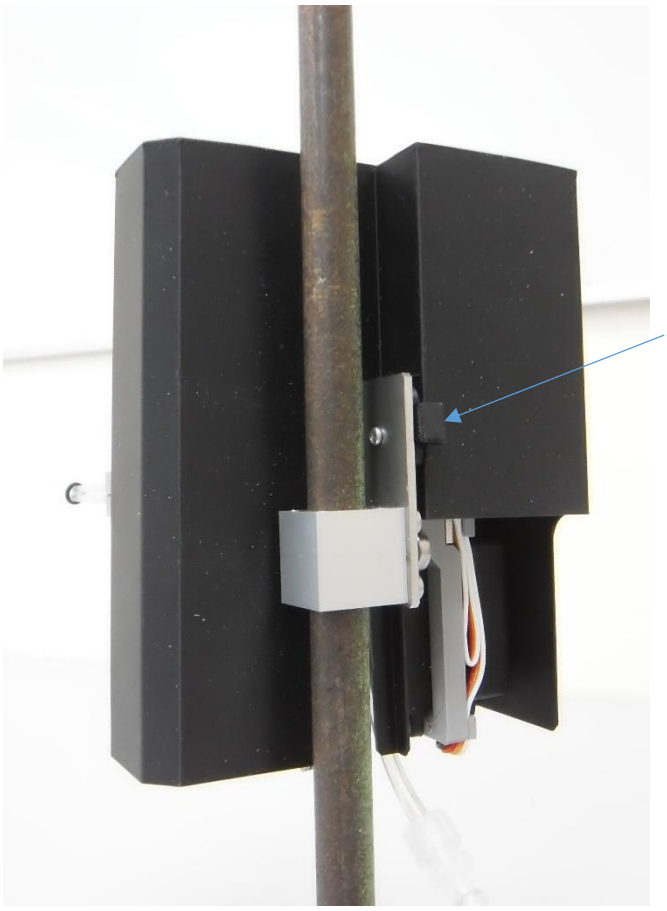
If the chamber is warm and the surrounding air is cool it is possible that the outlet pipe might have droplets of water condensing in it. Connect the outlet pipe to the controller inlet via the supplied hydrophobic filter 630-976 to catch these droplets that would otherwise cause damage to the gas analysis system. Fit the filter at the controller end of the white sleeved pipe which supplies air to the analyser.

It is not necessary to have a filter connected to the fresh air inlet which has a black sleeve.

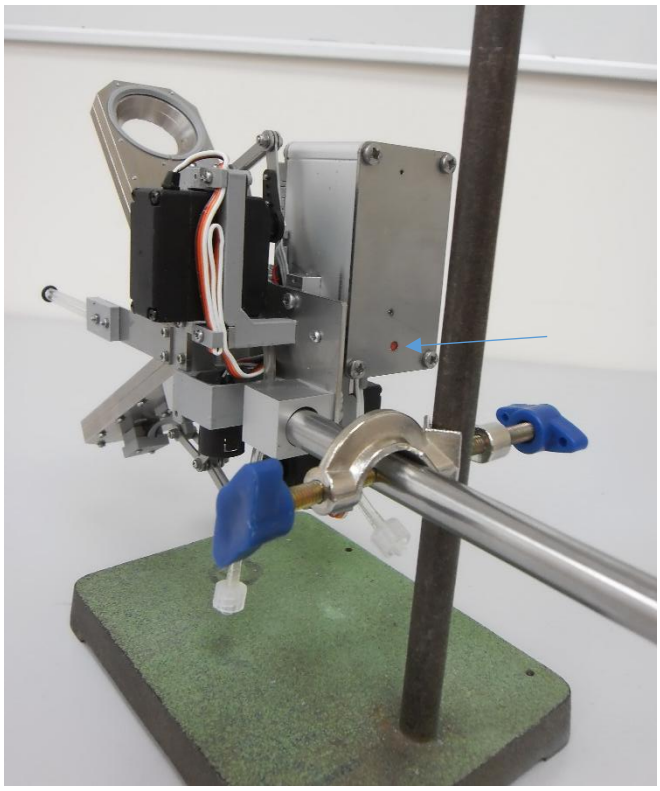
The chamber is intended to be mounted on rod of diameter 10mm or 12.7mm, which might be a retort stand or laboratory scaffolding. The adaptor sleeve is only used if the rod is 10mm.

A retort stand like the one shown in the photograph is available as an optional accessory, see ‘accessories’ on page 11.

The chamber is supplied with the jaws in the closed position for convenient transportation. When mounting the chamber on its support rod be sure that you have allowed enough height for the lower jaw to clear the base plate or shelf when it is in the open position to avoid the possibility of damage.



The cover may be added with the support rod vertical or horizontal
To unlatch it, lift this lever

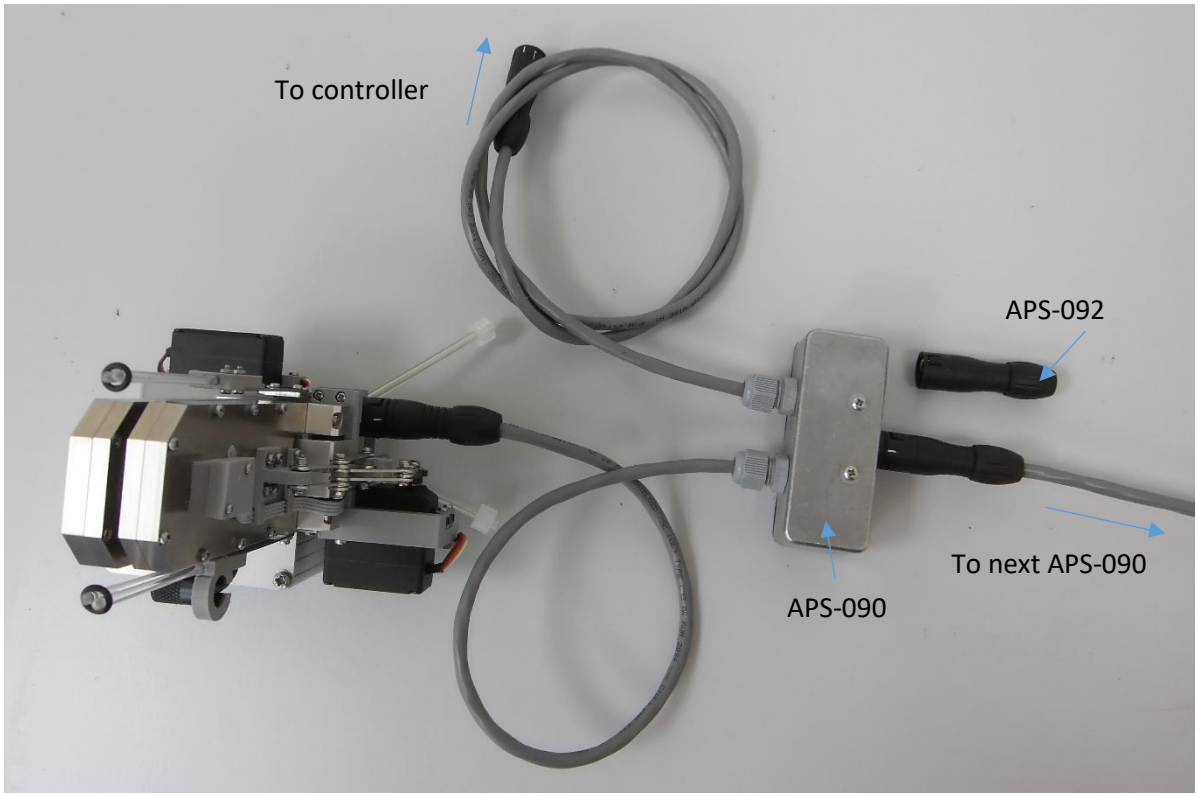


The chamber may also be attached to horizontal rods from the back or side. To do this it is necessary to remove, rotate and refit the mounting block

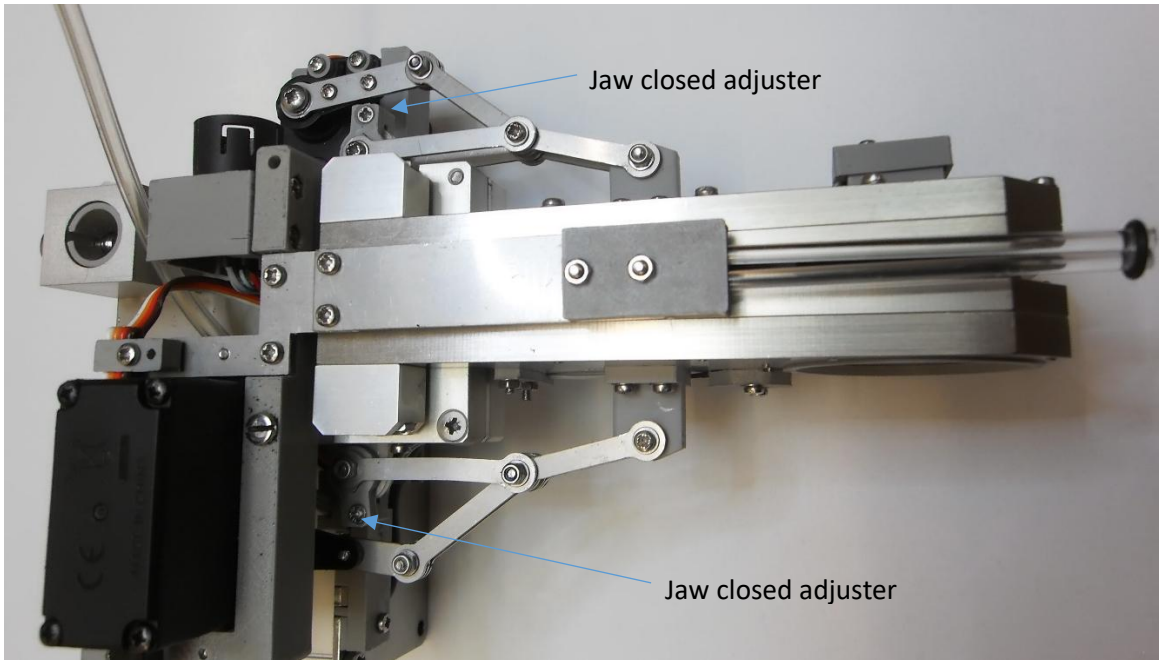
Note the red reset button (arrowed).

The red indicator light immediately above the reset button will illuminate when power is applied.

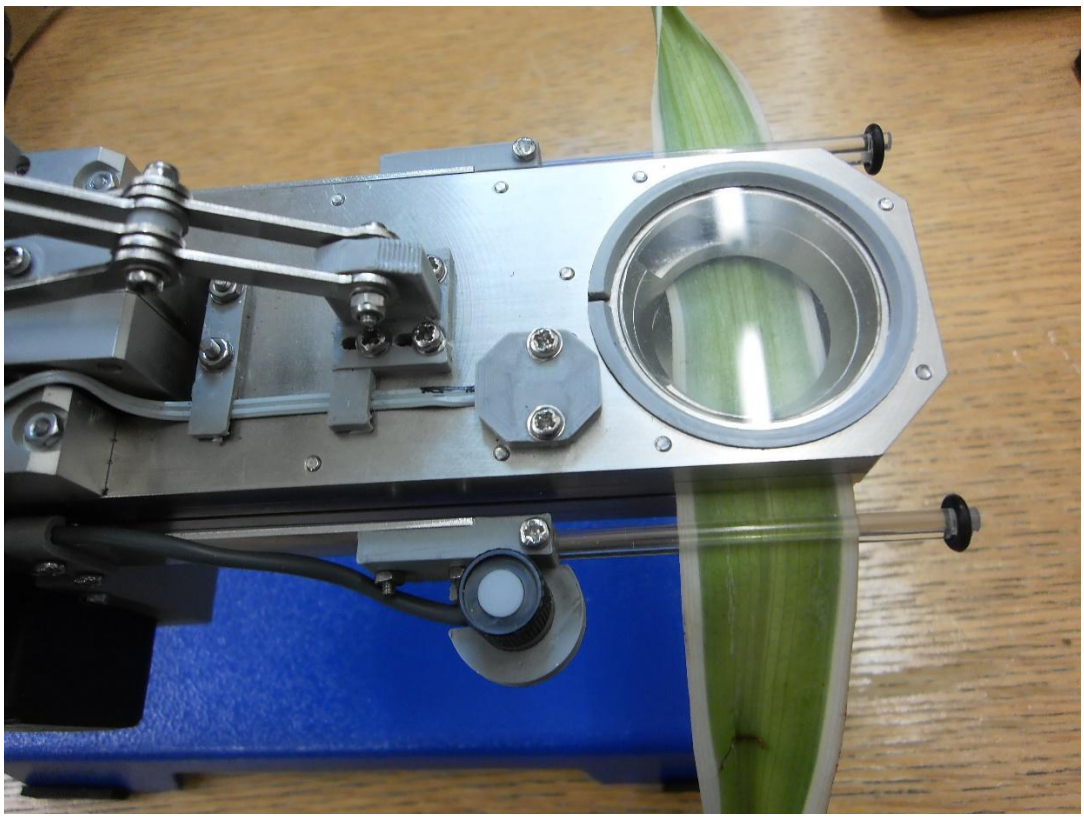
The top red indicator is a status light which will illuminate continuously or flash.



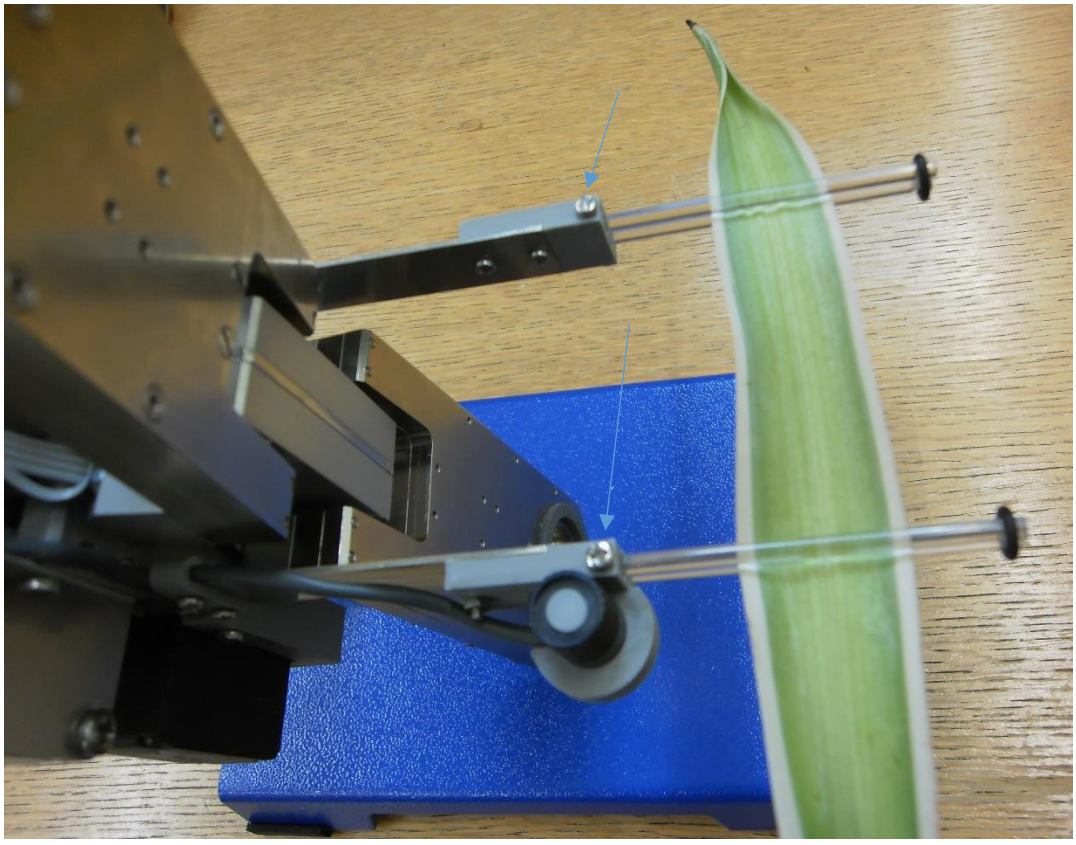
If you have only 1 chamber, the APS-090 cables connect it to the controller and the vacant socket on the connector box APS-090 has the terminator APS-092 connected to it. If there is a second chamber, its connector box connects to the vacant socket and the terminator is fitted instead to the second connector box (APS-090). In this way up to 10 chambers can be connected, the last one in the chain being fitted with the terminator plug (APS-092). 2 metre universal extension cables APS-091 are available, which can be fitted wherever needed.



When the chamber is connected to a controller, and has been closed by software request, these adjusters can be moved to make small changes to ensure that the gaskets are touching with no air gaps. Make this adjustment before using it on a leaf.



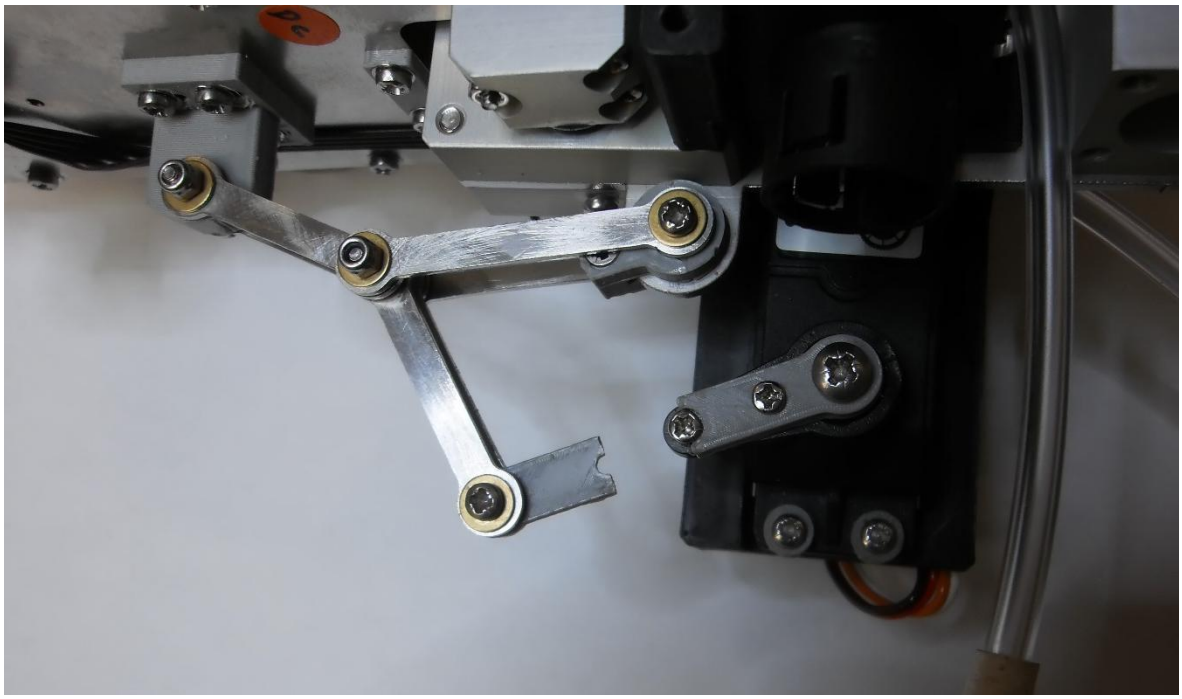
The transparent leaf guides are designed to hold the leaf so that it maintains a constant position relative to the closed position of the jaws, even when they are open.



They are retained by M2 pan head screws (shown, arrowed), which should by tightened till they just grip the guides. The guides may be replaced if they become damaged, and may be cut shorter using sharp side

cutters, or by making a cut around the rod with a sharp knife, and snapping. The leaf guide part number is APS145 for a single guide.

If the leaves are too small to be retained by the leaf guides, a helpful accessory is the leaf support net APS-189 which can be fitted to the leaf guides.



The plastic servo arms APS138 are intended to break as in the photo above if excessive forces are placed on the jaws, to prevent damage to the servo mechanism and to protect the user. The APS138 arms break at a closed clamp force of approximately 1.5 kg at the leaf position. They are supplied in the spares kit, are available as spares from ADC and are easily replaced using a pozidrive #1 screwdriver, a 5.5mm and a 4mm spanner or pliers.

Replacing gaskets

When removing old damaged gaskets, you may find that the backing adhesive remains firmly attached to the metalwork, rather than detaching with the old gasket. If this is the case, the best solvent for the adhesive is diesel, paraffin, or kerosene. Proceed as follows:
Having removed the sponge part of the gaskets, and with the jaws fully open, position the chamber so that the inner face of the jaws face upwards. Drip a couple of drops of the solvent into each of the gasket grooves (a closed pair of tweezers will hold a drop of solvent by capillary action), and leave to soak for 5 minutes. The gaskets and adhesive and its backing paper should now be removable with a cocktail stick. Use a cotton bud to clean away any residual adhesive and liquid and allow the solvent to evaporate in a warm room for 30 minutes. Take care, when removing the old adhesive from the jaw with the window, that none of the adhesive drops onto the inside face of the window because it is difficult to clean off.
The new gaskets can now be fitted.
You might find that leaving the central (waste) core in place, with its backing sheet remaining in place, during the fitting helps to keep the gaskets circular.

Adding extra chambers

Chambers are normally supplied with a 5 channel controller in a group of 5, numbered 1 to 5, or 10 for a 10 channel controller. If an additional chamber is purchased separately, it will be assigned address 90, which will be changed by the controller, when it is installed in as system to the next free available number.

Specifications

Width: 10.4 cm with cover
Length: 20cm
Height: 27cm
Weight without cover: 780g
Weight of cover: 40g
Power: 13.8V DC
Communications: RS485.
Connections: 1: Ground (0V); 2:DC positive; 3:RS485-A; 4:RS485-B; 5:Electrical screen (connect to ground)
Gas connections: 2 off, luer.
PAR: 0-3000 μmol m^{-2} sec^{-1}
Air temperature (top jaw): -20 to 90C +/- 0.5C. 0.1C resolution
Leaf temperature (bottom jaw): 0 to 50C +/-0.5C. 0.1C resolution
RH: 0 to 100% +/- 2%RH

Spares and accessories.

EGA-070 Filter assembly 1u, 50mm diameter, luer.
630-976 Hydrophobic Filter 1u, 50mm barbed.
706-100 Tube 8mm OD x 4.8mm ID.
APS-106 sponge window gasket (used in pairs).
APS-138 servo arm.
APS-145 Leaf guide rod. (75mm long)
APS-189 Support net for small leaves
650-459 O ring for leaf guide rod ends.
APS-104 window.
APS-090 power & data cable box assembly.
APS-092 Power & data termination plug (one per system)
APS-091 Power & data extension cable, 2 metres.
M.870-320 Retort stand.