TN 101.1
Improvements and Modifications to HPC1

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1. Scope

This document describes the modifications performed on the HPC1 based on some of the recommendations made at the end of the previous contract COO6 and following the batch culture campaign of the current COO9.

2. Reference and applicable documents

2.1 Applicable documents

AD1 COO9: HPC1 characterization phase in the MELiSSA Pilot Plant
AD2 MPP-QA-07-0001 MPP Quality Manual
AD3 MPP-QA-07-0003 MPP rules for good lab practices
AD4 MPP-UM-11-4000 HPC1 User Manual
AD5 MPP-PID-10-4101 PID of HPC1

2.2 Reference documents

RD1 TN-96.1 "Results of chamber reassembly at UAB"
RD2 TN 96.12: Cultivation as-run procedures, Test results and final Test report
RD3 TN 96.13 HPC1: conclusions and perspectives
RD4 TN 101.3: Test report for the characterization of lettuce batch cultures in HPC1
RD5 TN 96.11: Functional Testing with Schneider Controller – As-run procedures, Test results and final Test report

3. Acronyms/Definitions

MELiSSA	Micro Ecological Life Support System Alternative
MPP-CCL	MELiSSA Pilot Plant – Claude Chipaux Laboratory
HPC	Higher Plant Chamber
COO	Call-Off-Order (internal ESA acronym)
UoG	University of Güelph, Ontario

4. Proposed modifications

4.1 Short description

Following the completion of COO6, and the batch cultures of COO9, a series of issues was identified by the MPP personnel and the visiting scientist from Guelph (Dr R. Côté). These issues can be categorized in two groups: 1) those that affect the function and/or performance of the chamber and 2) those that are more related to maintenance and safety.

Within each group, these could also be classified in relation to the time they need to be addressed:

1. to be modified or performed prior to the beginning of the staggered experiment
2. to be modified or performed later since they should not impact the proposed staggered experiments
3. to be considered in the design of future chambers and reported in TN101.6

This document describes the items that were modified prior to the staggered culture experiment as described in the COO9, and modifications performed later, as they did not impact the proposed experiments.

4.2 HPC1 modifications

4.2.1 Addition of Metering pumps for injection of nutrient

In the original HPC1 design, the concentrate nutrient solutions A and B are stored in 4-litre reservoirs placed above the main hydroponic tank and gravity fed to the tank by the opening action of two solenoids valves, one per line (ASCO red hat valves, catalogue number 8262G220, MPP tags SV_4108_01/02). These valves are controlled by the HMI in response to the EC reading and the demand set point. Two issues were identified with this method of injection. First, the valves started to leak after an extended length of time. The volume leaked could not be estimated, therefore adding an unknown quantity of solution to the hydroponic loop. Second, the exact flow rates for the solution going through these valves were difficult to evaluate accurately. This inaccuracy comes from the fact that the flow rate of a gravity fed line depends on the height of the solution column. Furthermore, when very short pulses were used, the electronic and mechanical lag times of the system contributed to the inaccuracy of the measurement. The precise measurement of the flow rate is necessary to be able to convert the duration of the injection pulses to volume injected and then to quantity of nutrient added. It is also important to keep the volume of injection of both solutions identical to avoid ionic imbalance in the hydroponic solution.

In order to correct the above issues, the system was modified by adding two metering pumps (one per solution line, ProMinent gamma G/4b, Appendix 1, 2) which will control the volume of injection for nutrient solutions A and B. The metering pumps can be calibrated to deliver a very precise volume of injection and by their inherent design, decrease the chance of leakage of solution in the tank. It was decided to keep the original solenoid valves in place as an added level of control for leakage and to synchronize their opening actions with the injection pulses of the metering pumps. This design permits an accurate delivery of solution and when coupled with the additional valve will decrease the chance of leakage and avoid contamination during maintenance.

4.2.2 Pneumatic valves (Leaking Acid and Base Valves)

The valves for acid and base (ASCO red hat valves, catalogue number 8262G220, MPP tags SV_4107_01/02) have been replaced a couple of times in the past year since they have the tendency to leak and therefore inject unknown quantities of solution into the hydroponic system. They also pose some problems for the evaluation of the quantity injected into the system since they are not very reliable and difficult to calibrate. Because of this inaccuracy, the lab staff cannot rely on the time that the valve is opened and the flow rate to evaluate the quantity of nutrient injected, and have therefore developed an alternative method i.e. marks on the side of the solution reservoirs, that is not only cumbersome to apply but also only approximate. The method of injection should be more reliable and particularly not leak, in order to obtain accurate measurement of injected solutions. The problem with the acid and base injection is therefore very similar to the one presented in section 4.2.1, and therefore could also be resolved by adding two metering pumps. However, because of the high cost of such pumps and the possibility that the high concentration of the solution (particularly for the base) affected its mechanism, it was decided to postpone the decision to convert the acid/base component with a system similar to the one propose in section 4.2.1. Leakages were mostly observed for the acid and base injection, which can be explained by the corrosive nature of these solutions. Therefore for the injection of acid and base, two pressure operated membrane-valves will be installed (Appendix 3). The membrane valves will avoid further leakage. The accuracy is less than for the metering pumps, but it was decided that for the moment the accuracy of the acid and base measurement where not as critical as for the concentrated nutrient solutions.

4.2.3 Seedlings nursery

The germination of lettuce seedlings for their introduction into HPC1 has been variable from one week to another in the past, and based on the picture archive appeared etiolated, probably due to insufficient light levels. In order to produce more uniform seedlings, it was suggested to look at an alternative method of controlling the environment conditions during the germination stage. In the case of the staggered experiment, it would not be possible to start seedlings inside HPC1, therefore an alternative has to be found to provide appropriate level and quality of light, as well as the warmth and moisture required during this critical stage of growth. The method of germination has been modified and details can be found in MMP-OP-11-4101 Germination procedure. This method includes the use of a seedling nursery as described in section 5.3 below

4.2.4 Addition of a bolt stopper at each door hinge

The bolts of the HPC1 door hinges have tendency to slide out. An L-shaped stopper was designed and installed to prevent further sliding of the bolt that could end up with the door falling off of the chamber and on to the operator, being an important threat to personal safety.

4.2.5 Change to CO_2 injection algorithm

The algorithm for controlling the CO_2 injection into the chamber resulted in over injection and required two to four hours to stabilise. It was requested that Sherpa Eng. modify the algorithm to better reflect the time it takes for the chamber to disperse the injected CO_2. In addition, the maximum injection rate has been set to 500 mL/min (former value was 1000 mL/min, fixed injection rate) to increase the accuracy of the injection.

4.2.6 Gas Analyser system

Some minor modifications to the gas injection control panel have been made in order to accommodate an updated calibration procedure for the CAI gas analyser (Model 601). These include the addition of a particle filter and of an additional port for integrating a new bypass mode into the gas analyser operation. Modifications have been included in the latest update of the PID and user manual AD4

4.2.7 Air baffles for upper louvers (Uneven air flow in HPC)

The uneven growth observed on the batch cultures of lettuces was partially explained by an uneven air flow within the HPC chamber. This was confirmed by some velocity measurements performed by R. Moyano in May 2010 (see appendix 8) indicating higher velocity in the centre of the chamber (RD4, section 11.2). In order to improve air flow patterns, the two centre vents were replaced with custom made perforated plates (see fig.1). Velocity measurements and visual observations indicated that the air flow was much more uniform throughout the chamber after this modification (see Appendix 9). This was also confirmed by the last batch culture of lettuce where dry weight distribution was more uniform over the whole growing area (RD4).

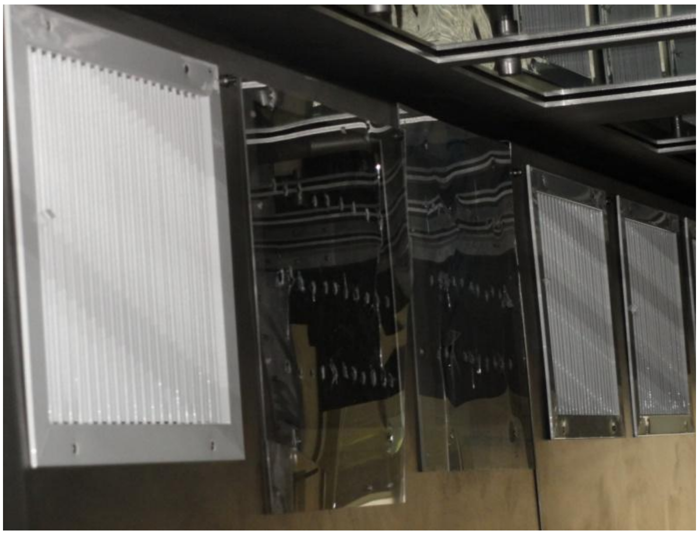


Figure 1: Upper perforated plates restricting air flow

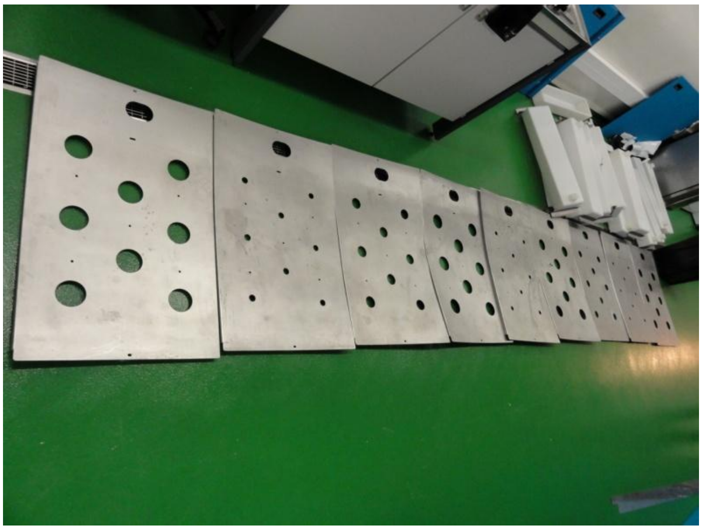


Figure 2: Configuration of bottom perforated plates currently used in the HPC (4 larges, 3 smalls, 2 mediums)

After close examination of the HPC chamber and experimental design, it was noticed that three factors may have contributed to the uneven distribution of air flow during the batch cultures of lettuce:
1) the order in which the perforated panels were placed at the bottom of the chamber (see fig.2),
2) the obstruction of the normal air flow between each tray caused by the presence of plastic sheets used to decrease the proliferation of algae on the rockwool medium (see fig.3), and
3) the adjustment of the upper air louvers.
In order to verify this hypothesis, a series of tests were designed to measure:

1. the impact of the lower baffle panels configuration on the air flow pattern
2. the impact of the plastic sheets placed over the whole surface of the chamber on the air flow pattern,
3. the impact of the perforated panels place over or behind the upper central louvers (see fig.1) on the air flow pattern

Figure 3: Overlapping of plastic between trays

Figure 4: UoG SS tray covers and trays

In order to identify the role that plays each component involved in the control of air flow in the chamber, an experiment was designed to evaluate the impact of different louver and baffle configurations, as well as that of the utilisation of anti-algae plastic film on the chamber air flow pattern. A test protocol for Velocity Measurement (MPP-TN-10-4102) was designed based on the previous mapping protocols developed by NTE and UAB and performed on HPC1 (NTE-HPC_HVAC-OF-001_2). The mapping was performed on two baffle configurations (MPP and original configuration engineered by Angstrom) using the louver configuration already in place (called MPP configuration). Tests were performed without plastic film and then repeated with plastic film only on the pair MPP-baffle configuration with MPP-louver configuration. From these measurements the following was concluded:

a. Plastic film affects the normal air flow pattern in the chamber and in the future precautions should be taken to avoid any obstruction of the space between trays either with the anti-algae film or any other component of the experimental design.
b. The configuration of the lower baffles had a lesser impact than the one of the louvers. The Angstrom configuration seems to provide a more even distribution of air.
c. The louvers seem to be the major controlling component of air flow for the upper part of the chamber and have a lesser impact at the level of the trays. Their adjustment in order to obtain an even flow across the chamber will therefore be more important when growing tall plant species.

4.2.8 Evaluation of Air lock and curtains seals

The functional test carried out on the air lock purge sequence failed (see RD5, section 3). This test to work properly would require for the air lock to be pressurized. The HPC1 and its air lock cannot be pressurised due to the presence of a permeable internal door and pressure compensation bags. The chamber was not designed to withstand any pressure gradient between the interior and the exterior of the system. Therefore, no test involving pressure valve as a controlled point could work without modifying the actual design of the chamber, i.e. replacing the curtains. Under those circumstances, a proper flush of the air lock space is not possible.

Instead of a purge, a series of measurement for CO_2 loss and diffusion rates were performed in order to characterize the perturbation on CO_2 concentration induced by the opening of the air lock doors. These tests estimated the quantity of CO_2 lost and could be used to mathematically correct the gas exchange and carbon balance data. This correction will improve the accuracy of the measurement, particularly during the staggered cultures since the door may need to be opened on a more frequent basis. The results of these tests will be reported in TN101.5.

The same test could also be applied to the O_2 gas. This required the installation of an O_2 input line with pressure regulator and manual valve (not performed). A protocol has been developed to evaluate the loss and diffusion rate of CO_2 and O_2 gases for the HPC1 (MPP-TN-10-4103).

4.2.9 Access to airlock compartment

The position of the airlock gloves is 140 cm from the ground, and the base of the airlock window is 165 cm from the ground. These dimensions make it very difficult for some MPP staff to work with the chamber gloveboxes. In order to improve accessibility and ease of work, two large polypropylene platforms of 16 cm in height were bought and placed below each air lock.

4.2.10 Software update

Some of the changes described above, such as the addition of metering pumps, required modification or addition to the data acquisition and control system. These are defined in sections 5.9 below.

4.2.11 Hydroponic Collecting Tray (Maintenance)

The large white polypropylene collection gully at the end of each growing tray is heavy, difficult to manipulate, difficult to clean and often leaks at the middle junction. Furthermore, the gully is in the way of the bottom baffles when there is a need to remove/ remountthem. It is therefore recommended to replace it with a 316 stainless steel tray that will be attached either on the wall of the chamber or on the supporting structure of the wheels track. Originally this should not have been a problem since the tray was not intended to be displaced and the baffles were expected to be removed only on rare occasion. However, changes in cleaning procedures, mapping experiments, characterisations, repairs of leaks and instruments have all increased the requirement for entering the chamber and removing the baffles, making the presence of this tray problematic. In order to improve the ease of operation and maintenance, a new light SS tray has been designed. Schematic drawings are provided in section 5.10 below.

5. Implemented Modifications

5.1 Addition of Metering pumps for injection of nutrient

5.1.1 Metering pumps

In order to correct the issues presented in section 4.2.1, the system was modified by adding two metering pumps (one per solution line) which will control the volume of injection for nutrient solutions A and B. The metering pumps can be calibrated to deliver a very precise volume of injection and by their inherent design, decrease the chance of leakage of solution in the tank.

The UAB laboratory had available two metering pumps that were not in use. These were installed on 26.01.11 for the injection of nutrient solutions A and B (see Figure 5). Specifications can be found in Appendix 1. Calibration and maintenance procedures are included in AD4

5.1.2 Solenoid valves

The solenoids used for the injection of nutrients have never shown sign of leakage in the past, they were therefore kept for added control on the injection and decrease the chance of contamination during pumps maintenance. The opening of these valves needed to be synchronized with the injection pulses of the metering pumps, which required minor modifications to the software control system. This design permits an accurate delivery of solution and when coupled with the additional valve will decrease the chance of leakage and avoid contamination during maintenance.

5.1.3 Support shelf

The installation of these pumps required the installation of a supporting shelf in order to place the pumps in the right position in relation to the feeding reservoir according to the manufacture's specifications.

Metering pump	Solenoid valves

Figure 5: Metering pumps and solenoids valves used for nutrient solutions injection

5.1.4 Software modifications

In order to properly operate these pump the control system had to be updated:

- Modify the control software to synchronise the operation of the pump with the opening of its associated valve, this was done in using the same signal pulse
- Add a user input field to the HMI so the user can enter the real flow rate as measurement using the procedure describe in MPP-User-Manual
- Since the flow rate of both pumps may not be exactly the same, the controller includes this discrepancy into the calculation of injection time for both pumps. For example, if a pump flow rate is half the flow rate of the other pump, the injection time for this pump should be double in order to inject the same volume. Sherpa Eng. has implemented this change by using one pump as a reference and correction the time of injection of the other pump based on the ratio between the flow rates of both pumps. (Note: in normal operation the difference between the two pumps should be less than 10%, if the difference is higher, then it is time to perform a manual calibration and adjustment of the pump speed.)
- Sherpa Eng. implemented a control that stops the injection of both solution if one of the low flow alarms is triggered, in order to avoid injecting one solution and not the other which may create an ion imbalance in the hydroponic solution
- Sherpa Eng. added a new tags representing the values converted from “injection time” (sec) to “volume injected” (ml) using the “user input” value for flow rates.

5.2 Leaking Acid and Base Valves

5.2.1 Pressure operated membrane-valves

The valves for acid and base injection have been replaced more than once in the past year due to their tendency to leak and therefore transfer unknown quantities of solution into the hydroponic system. The decision was to replace the conventional solenoid valves with pneumatically operated membrane-valves (performed by the company CIFA – see the documented interventions in Appendix 10: CIFA’s report on maintenance interventions in the MPP). These have a more reliable mechanism to prevent leakage due to the high pressure applied to the membrane. Furthermore, the solution never comes in contact with the metal components of the valve therefore preventing corrosion and potential leakage. The installation of these valves required a compressed air pipeline. They are also larger than solenoids and require more space. The procedure to measure the flow rate can be found in AD4. Specifications for the valves can be found in *Appendix 3: **Specification of pressure operated membrane-valves***. Figure 6 shows the electro-pneumatic block to activate the two valves, and the two valves installed at the same position as the old solenoid valves.

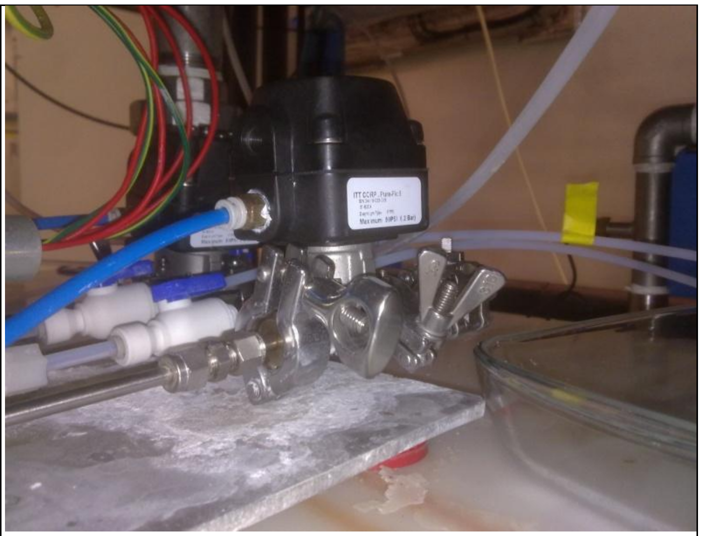
	
Pressure regulators	Pneumatic membrane valve

Figure 6: Pressure operated membrane valves

5.2.2 Software modifications

In order to properly operate these valves the control system had to be updated:

- add a user input field to the HMI so the user can enter the real flow rate as measurement using the procedure describe in AD5
- Sherpa Eng. added a new tag representing the values converted from "injection time" (sec) to "volume injected" (ml) using the "user input" value for flow rates.

5.3 Seedlings Nursery

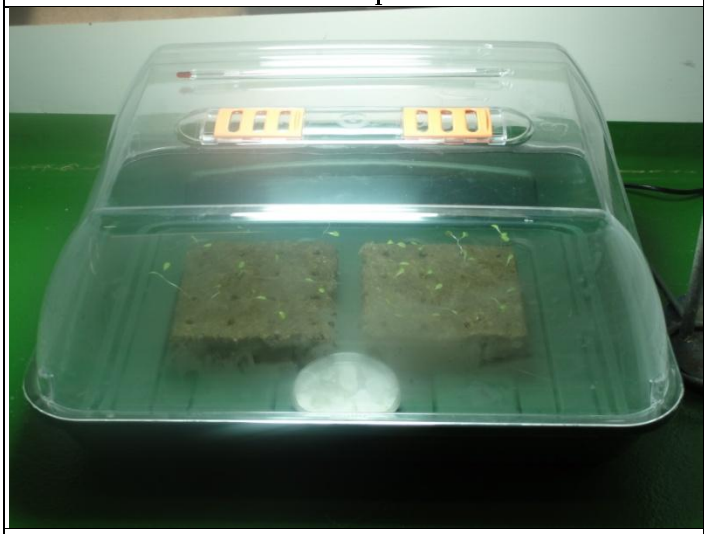
5.3.1 Nursery components and assembly

In order to provide the seedlings with the appropriate growing condition and to obtain a more uniform seedling population between crops, a small nursery was constructed using the following components (see Figure 7 and *Appendix 4: **Specifications for nursery components***):

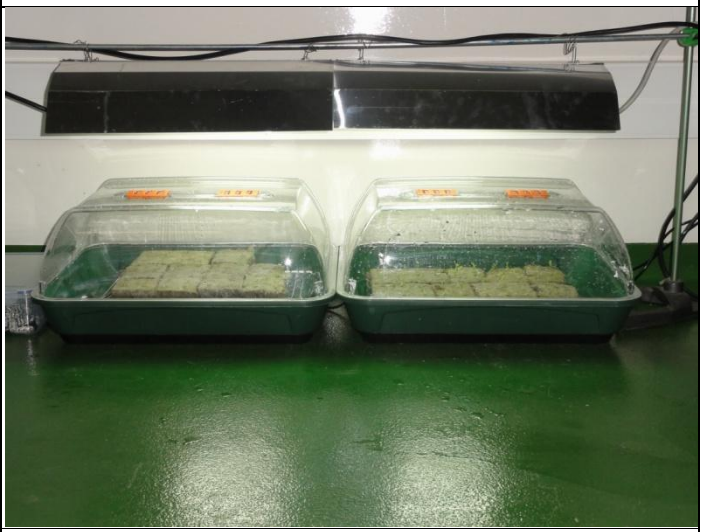
- Lamp 105 W Agrolite
- Metal reflector Basic Liso
- Programmable timer
- Heated grow tray with domes "Hivernadero Grande" 50 x 30 x 15 with heating mat set to 24ºC
- Metal grid for rockwool cubes
- Metal support for light reflector

Lamp

Reflector



Nursery tray



Trays and light set-up

Figure 7: Nursery components and assembly

5.3.2 Nursery assembly

The light metal reflectors are firmly attached to the metal support bar which is itself attached to adjustable clamps. The clamps permit the adjustment of the light level by raising or lowering the light support bar (Figure 7). Light is adjusted to a height that delivers between 200 and 250 $\mu mol.m^{-2}s^{-1}$ PAR at seed level (i.e. top of rockwool cubes). The bottom heated trays are connected to a standard power source and will maintain temperature to a minimum of 24°C (24 hours per day). The heat will generate a moist and warm atmosphere if water is present in the growing tray. The lamps are connected to a programmable timer set for a day/night cycle of 16/8 hrs (could be different depending on the experimental design, but should be synchronised with the HPC photoperiod).

5.3.3 Nursery verification of proper assembly

The light level should be monitored at the beginning of each experiment to ensure that the light level is within acceptable limit, otherwise the height of the reflectors should be adjusted until an acceptable level is reached. Caution: the light should never be closer than 15 cm from the dome, if at that distance the light level cannot be reached, new lamps should be purchased or replaced with higher wattage.

A thermometer should be placed in the nursery tray and temperature should be verified each time that the nursery is being checked for watering. Temperature should never go above 30 degrees C or below 24 degrees C. If temperature is below 24, the heated mat is damaged and the tray needs to be replaced. If temperature is above 30 degree, the light source could be too closed to the dome or the mat overheating. Temperature should be checked at the beginning of each experiment, particularly after long period of storage. Caution: always check temperature after a 24 hour period before using if the nursery has been stored for a long time.

5.3.4 Location of nursery

If the nursery is kept closed, its location is less critical as long as there is no drastic change in temperature or light level. However, if the trays are used without their domes or the domes are opened frequently, it is preferable that the nursery be located in a clean location away from doors, sinks, and areas of high traffic. For certain plants, photoperiod is very important, so even if you control the photoperiod above the tray, if there is a strong source of light nearby during the dark period of your set photoperiod, the plant could be affected by this external source and will result in unexpected growth and development. In this case, the tray should be moved away from the source or shaded from it.

5.3.5 Storage of nursery components

If the nursery is not going to be used for an extended period of time, the tray and dome should be cleaned and disinfected with hypochlorite. The lamps should be removed and placed in their original boxes or an alternative method to prevent them from breaking. All components should be wrapped with some plastic to prevent accumulation of dust and stored in a clean place.

5.3.6 Spare parts

The laboratory should keep in storage at least two spare lamps. It is also recommended to keep one nursery tray and one programmable timer.

5.4 Addition of bolt stoppers at each door hinge

The bolt of each door hinge had the tendency to slide vertically out of their nominal position. An L-shaped stopper was installed for each of the 4 door hinges. (See Figure 8)

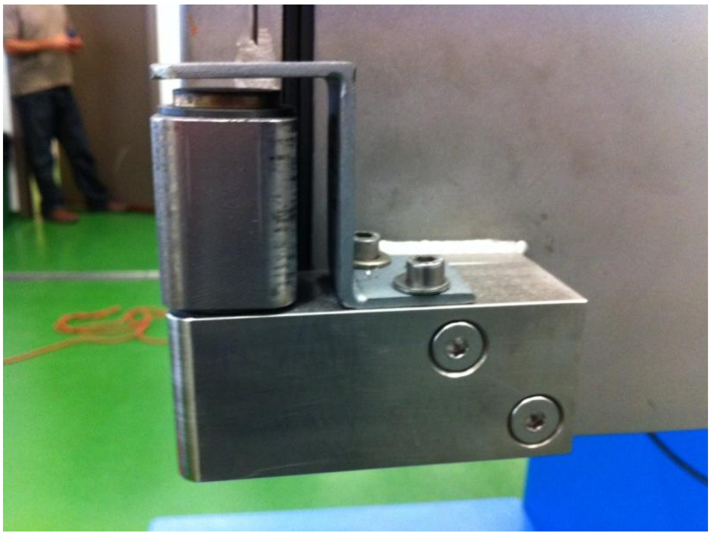


Figure 8: Bolt stopper at HPC1 door hinge

5.5 Changes to CO_2 injection algorithm

Sherpa Eng. has improved the CO_2 injection algorithm to avoid over injecting CO_2 in the chamber (see Section 6.2.5).

5.6 Gas Analyser system

The calibration procedure of the gas analyser (CAI instruments Model 601) has been modified in order to be conform to the manufacturer recommendations. The new calibration procedure is described in AD4.
Three modifications were made (see Figure 9):

- Add a bypass line to the gas system to permit allow disconnection of the gas analyser from the chamber when gas analysis is not required. It is highly recommended that this bypass configuration is used while performing cleaning, repairs or any other operations in the chamber that do not require the monitoring of gases in order to avoid damage to the equipment.
- The updated calibration procedure recommended keeping the analyser ON at all times. This was decided after discussion with other users and the CAI technical support. This analyser needs at least 24 hours to reach a steady state after being turning on, so the previous calibration protocol did not permit to reach steady state during calibration since the equipment was constantly being turned OFF.
- A particle filter was added to the inlet gas line to protect the analyser.

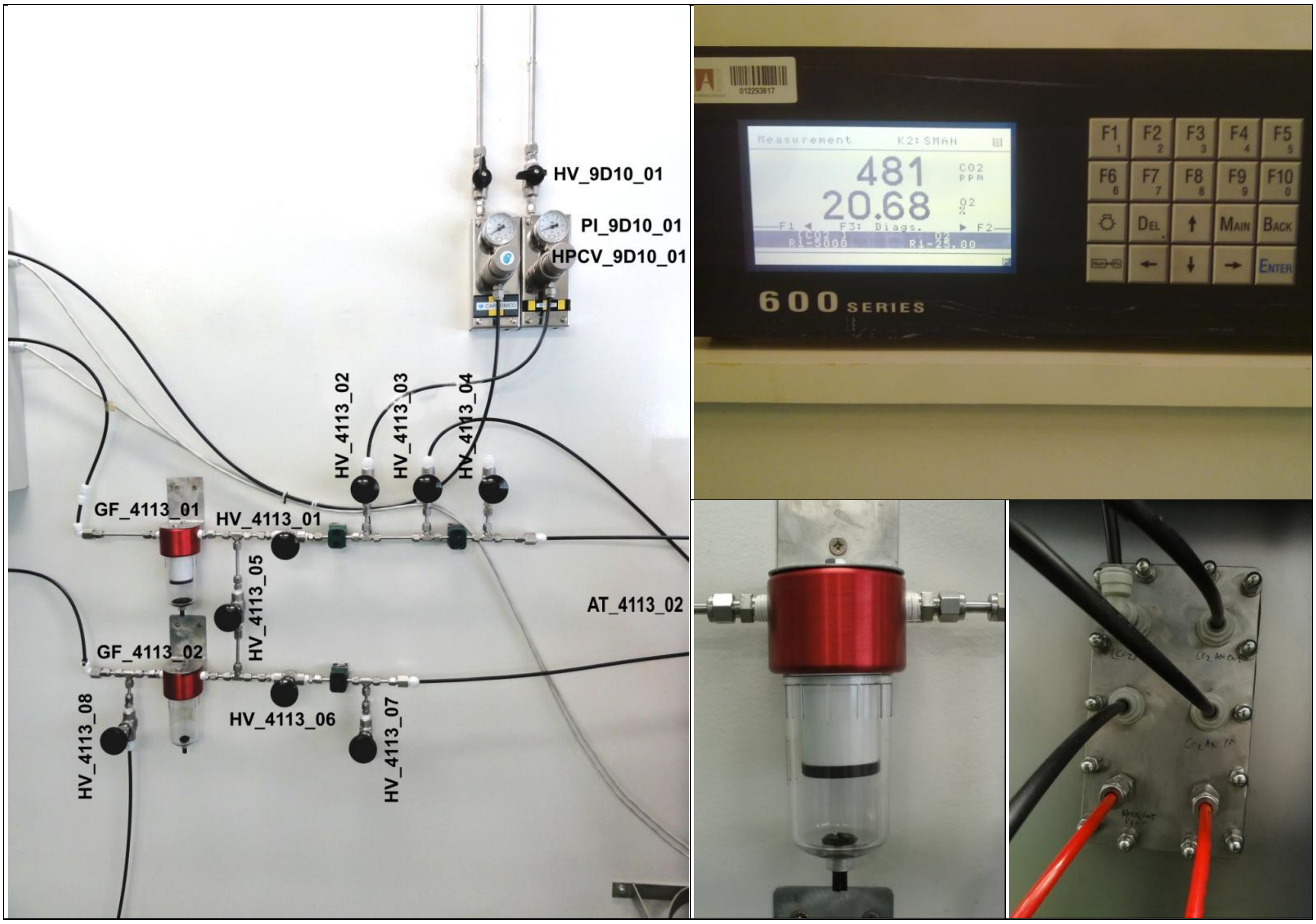


Figure 9: Gas Analyser System

5.7 *Air baffles for upper louvers (Uneven air flow in HPC)*

The results of the tests performed to improve the airflow distribution inside the chamber are shown in *Appendix 5: Air baffles for upper louvers experimental results*
The main conclusions of these tests were:

- Although the impact of the bottom baffle (perforated plates) distribution was minimal, the original Angstrom configuration was kept as it provided a slightly more homogeneous distribution at plant level.
- It was decided to discontinue overlapping of the plastic sheets used to cover the trays during the tests, as this causes a restriction to the airflow and increases strongly the air velocity, especially at plant level.
- Additional perforated steel plates were added in the back of two of the upper louvers (the second and third louvers of module B) in order to improve the homogeneity of the air velocity distribution (see Figure 10), that showed a very high peak between trays 10 and 15 at the plants level.

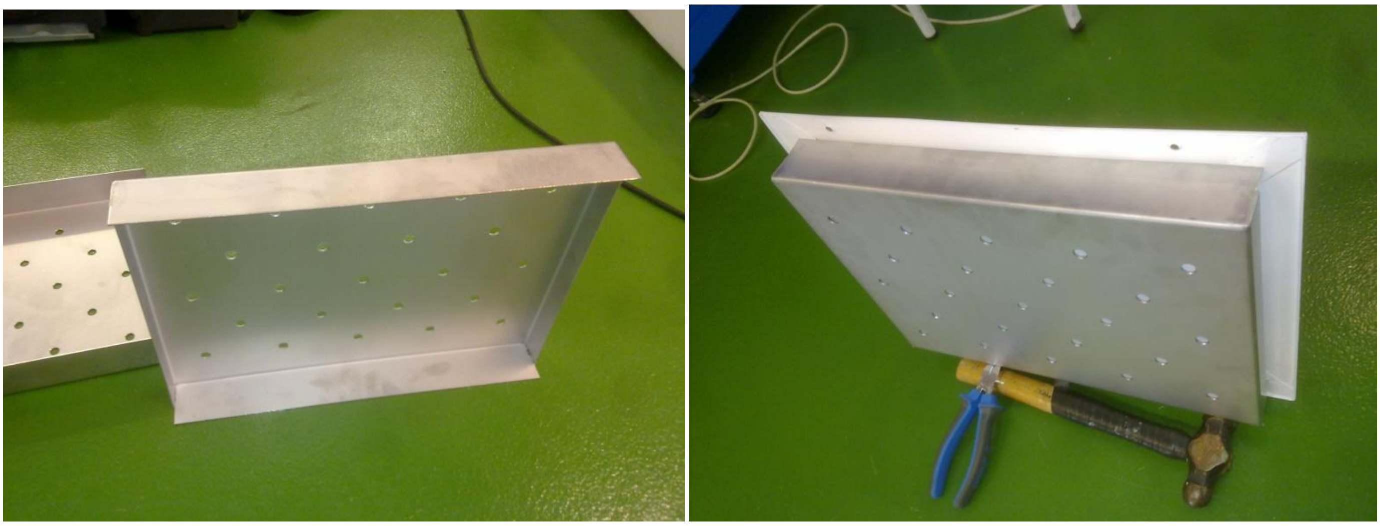


Figure 10: perforated steel plates installed at the back of some of the upper louvers in the HPC

5.8 Access to airlock compartment

The utilisation of the airlock glove boxes was difficult for shorter personnel. The usage of a small ladder presented some problems with their instability and the restricted area that could be used. The addition of two non-slippery pallets “Maestro Alligrip” in high density polyethylene (PEhd) of 800 x 1200 x 158 mm from Manutan (Manutan, S.L., 6-8 Edif. Conata 11 2ª pta 4°, 08970 Sant Joan Despi, Barcelona) permits an easier access to the airlock and its large surface makes manipulation safe and comfortable (Figure 11).

Figure 11: Access platform to HPC1 airlocks

5.9 Software update

Sherpa Eng. documented interventions are included in *Appendix 6: Sherpa Engineering report on maintenance interventions in the MPP*, and the corresponding NTE actions on HMI and control hardware are shown in
Appendix 7: NTE report on maintenance interventions in the MPP.

5.10 Hydroponic Collecting Tray (Maintenance)

New tray has been designed but the latest modification to the design has not been delivered as of September 2011 (see Figure 12) and so it was not implemented before the staggered experiment.

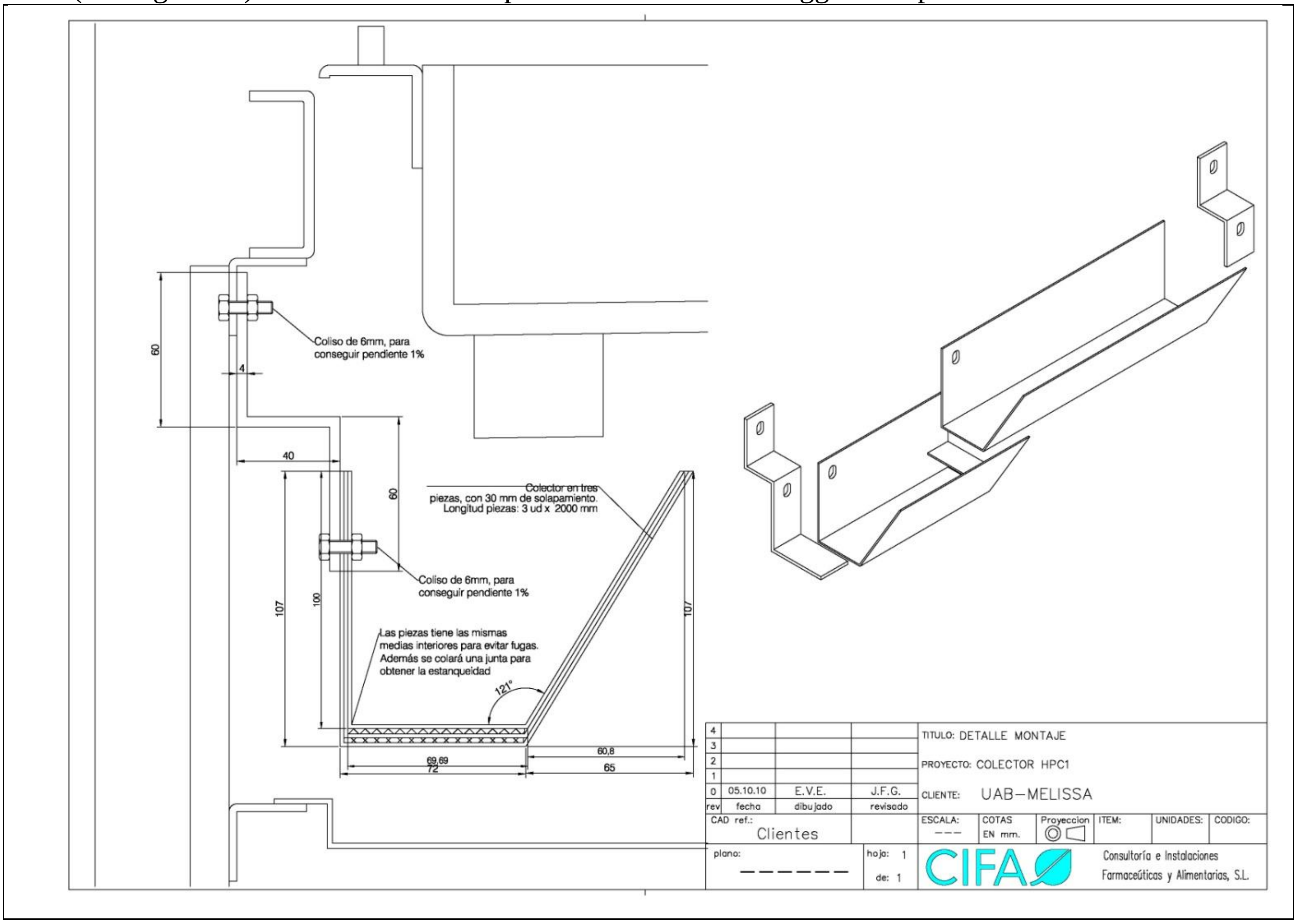


Figure 12: Stainless Steel Hydroponic Collector Tray

6. Conclusions

As described in the previous sections of this document, the following hardware and software improvements have been implemented in the HPC1:

- Addition of metering pumps for nutrient injections; update of software accordingly

- Installation of new pneumatically actuated membrane valves for acid and base addition; update of software accordingly
- Installation of a new seedling nursery
- Addition of a bolt stopper on the door hinges
- Change of CO_2 injection algorithm
- Improvement of the gas analyser system
- Changes in the configuration of baffles and louvers for air flow distribution
- Improvement of access to airlock glove boxes

The global chronology of detailed interventions (performed by the companies CIFA, SHERPA and NTE) is shown in *Appendix 11*.

Other modifications were postponed as the hardware was not ready or the design had not been completely defined at the time of starting the staggered culture:

- New hydroponic solution collector tray
- Improvements in the fitting of the blower or blower replacement
- Alternative liquid flowmeter
- Alternative air flow meter
- Alternative condensate pump
- Alternative air distribution grids

7. Comments

Results of improvements and modifications to HPC1

Comments

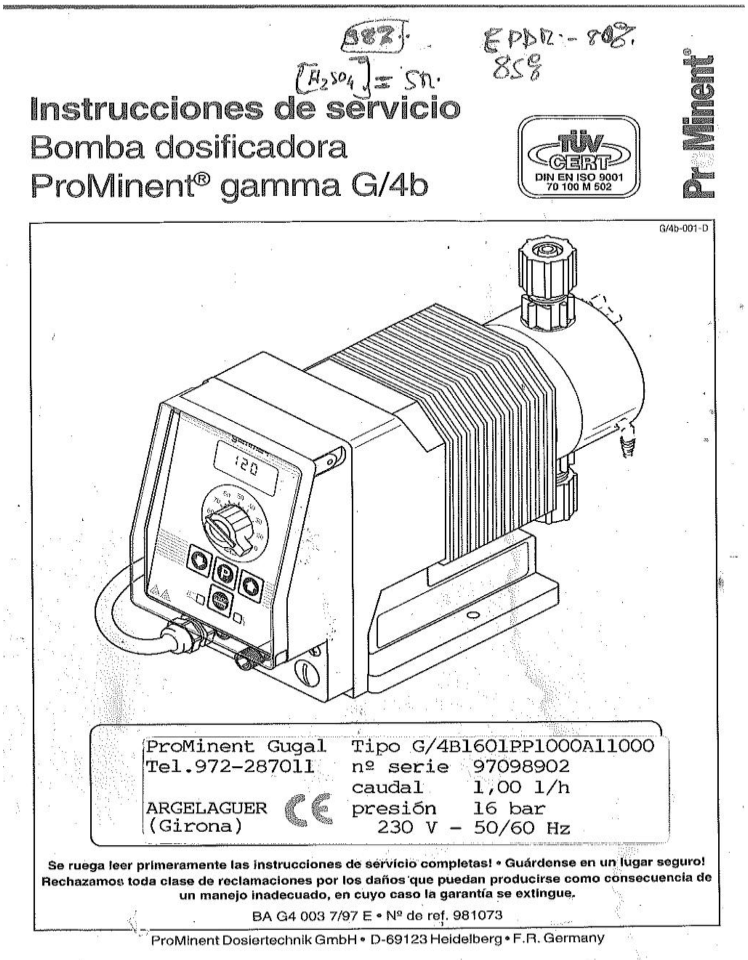
General comments

The unique comment we have on TN 101.1 is about the recording of the date the HPC modifications were performed.
Some of them can be identified in the maintenance reports attached in annex (e.g. solenoid valves in CIFA report), for others it is less clear (e.g. installation of the metering pumps).
For the sake of clarity, it would be useful to have only one maintenance report for HPC, to see clearly, chronologically, all the interventions on HPC. It seems that you have 1 excel file for NTE/SHERPA and another one for CIFA (some actions have the same numbers), is it correct? Can you please clarify these points?

- The date of installation of the metering pumps has been précised (Section 5.1.1, page 11)
- The global summary of interventions (chronologically) has been added as Appendix 11 (page 65), compiling the three maintenance reports of the different subs, and it is referred to in section 6. Conclusions (page 20).

8. Appendices

Appendix 1: *Specifications of nutrient metering pumps*



Instrucciones de servicio
Bomba dosificadora
ProMinent® gamma G/4b

TÜV CERT DIN EN ISO 9001 70 100 M 502

ProMinent®

G/4b-001-D

ProMinent Gugal
Tel.972-287011
ARGELAGUER
(Girona)

Tipo G/4B1601PP1000A11000
nº serie 97098902
caudal 1,00 l/h
presión 16 bar
230 V - 50/60 Hz

Se ruega leer primeramente las instrucciones de servicio completas! • Guárdense en un lugar seguro! Rechazamos toda clase de reclamaciones por los daños que puedan producirse como consecuencia de un manejo inadecuado, en cuyo caso la garantía se extingue.

BA G4 003 7/97 E • Nº de ref. 981073

ProMinent Dosiertechnik GmbH • D-69123 Heidelberg • F.R. Germany

Salida de relé (9) Sirve para la teletransmisión de señales del aviso de fallo o bien para generar los impulsos para el control externo de p.ej. una segunda bomba dosificadora ProMinent® que trabaja en régimen sincronizado.

Posibilidades de ajuste de la salida de relé:

Alarma general Alarma previa del control de nivel y desconexión final de la bomba, control de dosificación, fallos del sistema, aviso de fallo de los fusibles y de la red. Principio de funcionamiento: el relé vuelve al estado de reposo en caso de alarma (normalmente cerrado).

Relé de alarma Alarma previa del control de nivel y desconexión final de la bomba, control de dosificación, fallos del sistema. El relé se excita en caso de alarma (normalmente abierto).

Relé generador de impulsos Con generación de impulsos paralelos a cada impulso del electroimán de la bomba. Duración del contacto: 150 mseg.

Relé temporizador Permite programar hasta 31 tiempos de dosificación diferentes (con intervalos de 1 minuto a 24 horas), con reiteración diaria o semanal.

> **Una descripción detallada puede verse a partir de la página 72.**

3 Características técnicas

3.1 Datos de potencia (con 120 impulsos/min)

gamma/4b, tipo	1000	1601	1201	0803	1002	1002 HV	0308	0215
Caudal (l/h)	0,2	1,0	1,7	3,4	2,3	1,7	8,4	14,8
Caudal (ml/impulso)	0,027	0,14	0,24	0,48	0,32	0,24	1,17	2,05
a contrapresión máxima (bar)	10	16	12	8	10	10	3	1,5
Caudal (l/h)	0,27	1,2	1,9	3,8	2,6	2,5	9,1	15,8
Caudal (ml/impulso)	0,036	0,17	0,27	0,53	0,36	0,34	1,27	2,20
a contrapresión máxima (bar)	5	8	6	4	5	5	1,5	1
Altura de aspiración (mCA)	1,5	6	6	3	6	6	6	1,5
*Altura de aspiración inicial con lalongitud de la carrera ajuste al 100% (m) ***	0,5	1,8	2,5	2,8	1,0	-	1,8	1,5
Presión previa admisible en la aspiración (bar)	8,0	8,0	5,5	3,0	3,0	3,0	1,5	0,8
Frecuencia máxima de impulsos max. Hubfrequenz (impulsos/min)	120	120	120	120	120	120	120	120
*Material del cabezal dosificador *** con conexiones de aspiración/impulsión ****	PP NP TT SS	PP NP TT SS	PP NP TT SS	PP NP TT SS	PP NP TT SS	PP - - -	PP NP TT SS	PP NP TT SS
Conexión Ø ext. x Ø int. (mm)	6x4	6x4	6x4	6x4	8x5	DN10	8x5	12x9
Potencia absorbida media a una frecuencia máxima de 120 impulsos/min (W)	Ver placa de características							
Pico de corriente absorbido al efectuar un impulso (A)	Ver placa de características							
Peso, PP, NP, TT (kg)	2,7	2,7	2,7	2,7	2,9	2,9	2,9	3,1
Peso, SS (kg)	3,4	3,4	3,4	3,4	4,1	4,1	4,1	4,7

** Alturas de aspiración inicial con las válvulas limpias y humedecidas, trabajando con agua; tubo de aspiración conforme a lo indicado.

Materiales en contacto con el medio en la ejacución	Cabezal dosificador	Conexión de aspiración/impulsión	Juntas	Bolas
PP1	polipropileno	polipropileno	EPDM	cerámica
PP2	polipropileno	polipropileno	FPM (Viton A)	cerámica
PP3	polipropileno	polipropileno	FPM (Viton B)	cerámica
PP4[1)]	polipropileno	polipropileno	EPDM	cerámica
NP1	Plexiglas	PVC	FPM (Viton A)	cerámica
NP2	Plexiglas	PVC	EPDM	cerámica
NP3	Plexiglas	PVC	FPM (Viton B)	cerámica
TT1	PTFE (Teflón grafitado)	PTFE (Teflón grafitado)	PTFE (Teflón)	cerámica
SS...	acero inoxidable[2)]	acero inoxidable[2)]	PTFE (Teflón)	cerámica

[1)] PP4 con muelles de Hast. C en las válvulas; [2)] material nº 1.4571
DEVELOPAN® = membrana dosificadora recubierta de Teflón
Plexiglas® y Viton® (FPM) son marcas registradas.

Características técnicas

3.2 Datos de potencia (con 120 impulsos/min)

gamma/4b, tipo	1001	1602	1203	0806	1003	1003 HV	0313	0223
Caudal (l/h)	0,3	1,5	2,5	5,3	3,4	3,0	13,0	23,0
Caudal (ml/impulso)	0,027	0,14	0,24	0,48	0,31	0,28	1,20	2,13
a contrapresión máxima (bar)	10	16	12	8	10	10	3	1,5
Caudal (l/h)	0,42	1,8	2,9	5,6	3,7	3,7	15,5	25,5
Caudal (ml/impulso)	0,038	0,17	0,27	0,53	0,34	0,34	1,43	2,36
a contrapresión máxima (bar)	5	8	6	4	5	5	1,5	1
Altura de aspiración (mCA)	1,5	6	6	3	6	6	6	1,5
Altura de aspiración inicial con lalongitud de la carrera ajuste al 100% (m) **	0,5	1,8	2,5	2,8	1,0	-	1,8	1,5
Presión previa admisible en la aspiración (bar)	8,0	8,0	5,5	3,0	3,0	3,0	1,5	0,8
Frecuencia máxima de impulsos max. Hubfrequenz (impulsos/min)	180	180	180	180	180	180	180	180
Material del cabezal dosificador *** con conexiones de aspiración/impulsión ***	PP NP TT SS	PP NP TT SS	PP NP TT SS	PP NP TT SS	PP NP TT SS	PP - - -	PP NP TT SS	PP NP TT SS
Conexión Ø ext. x Ø int. (mm)	6x4	6x4	6x4	6x4	8x5	DN10	8x5	12x9
Potencia absorbida media a una frecuencia máxima de 120 impulsos/min (W)	Ver placa de características							
Pico de comiente absorbido al efectuar un impulso (A)	Ver placa de características							
Peso, PP, NP, TT (kg)	2,7	2,7	2,7	2,7	2,9	2,9	2,9	3,1
Peso, SS (kg)	3,4	3,4	3,4	3,4	4,1	4,1	4,1	4,7

** Alturas de aspiración inicial con las válvulas limpias y humedecidas, trabajando con agua; tubo de aspiración conforme a lo indicado.

Materiales en contacto con el medio en la ejacución	Cabezal dosificador	Conexión de aspiración/impulsión	Juntas	Bolas
PP1	polipropileno	polipropileno	EPDM	cerámica
PP2	polipropileno	polipropileno	FPM (Viton A)	cerámica
PP3	polipropileno	polipropileno	FPM (Viton B)	cerámica
PP4[1]	polipropileno	polipropileno	EPDM	cerámica
NP1	Plexiglas	PVC	FPM (Viton A)	cerámica
NP2	Plexiglas	PVC	EPDM	cerámica
NP3	Plexiglas	PVC	FPM (Viton B)	cerámica
TT1	PTFE (Teflón grafitado)	PTFE (Teflón grafitado)	PTFE (Teflón)	cerámica
SS...	acero inoxidable[2]	acero inoxidable[2]	PTFE (Teflón)	cerámica

[1] PP4 con muelles de Hast. C en las válvulas; [2] material nº 1.4571
DEVELOPAN® = membrana dosificadora recubierta de Teflón
Plexiglas® y Viton® (FPM) son marcas registradas.

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Características técnicas

3.3 Datos técnicos válidos generales

Variación del caudal	en todos modelos en los diferentes materiales disponibles - 5% a +15%
Precisión de dosificación repetitiva	± 2% en caso de empleo conforme a lo indicado en las instrucciones de servicio
Temperatura ambiente admisible	- 10 °C a +45 °C
Resolución del ajuste del recorrido	1:20
Conexión eléctrica	230 V, 0,85 A, 50/60 Hz 115 V, 1,65 A, 50/60 Hz
Rango de voltajes	207 V a 254 V; 108 V a 135 V
Clase de protección	IP 65
Clase de aislamiento	F
Conexión adicional	- Nivel de tensión cuando los contactos están abiertos : aprox. +5 V - Resistencia de entrada : 10 kOhmios - Control : con contactos libres de potencial o semiconductores con una tensión residual < 700 mV; la carga de contacto es de aprox. 0,5 mA a +5V.
Entrada de contactos	- Nivel de tensión cuando los contactos están abiertos : aprox. +5V - Resistencia de entrada : 10 kOhmios - Control : con contactos libres de potencial o semiconductores con una tensión residual < 700 mV; la carga de contacto es de aprox. 0,5 mA a +5V. - Frecuencia máxima de impulsos : 40 impulsos/seg - Duración necesaria del contacto : 20 mseg
Función opcional: Control analógico - Corriente	- Carga aparente : aprox. 70 ohmios - Corriente máxima de entrada : 50 mA
Opción relé Relé avisador de error Carga de contacto máxima:	- 250 V – 2 A, con separación de potencial
Relé secuenciador – Carga de contacto máxima:	- 42 V – 0,1 A, con separación de potencial

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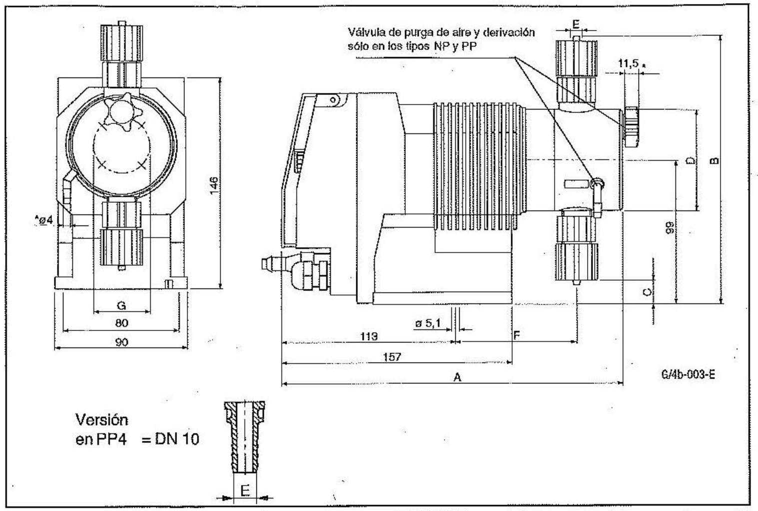
4 Medidas de montaje



gamma/4b		A	B	C	D	E	F	G
1000, 1001, 1601, 1602, 1201, 1203	*PP*	232	186	17	70	6x4	81	38
	NP	230	179	19	70	6x4	81	38
	TT	213	173	25	60	6x4	79	38
	SS1	211	164	34	60	6x5	79	38
	SK1	211	162	36	60	1/8"	79	38
0803, 0806	*PP*	232	186	17	70	6x4	81	38
	NP	230	179	19	70	6x4	81	38
	TT	213	178	20	70	6x4	79	38
	SS1	211	169	29	70	6x5	79	38
1002, 1003	*PP*	225	186	17	70	8x5	76	50
	NP	223	187	11	85	8x5	76	50
	TT	216	206	-8	80	8x5	79	50
	SS1	214	206	-8	80	8x7	77	50
0308, 0313	*PP*	225	186	17	70	8x5	75	50
	NP	223	187	11	85	8x5	75	50
	TT	216	206	-8	80	8x5	79	50
	SS1	214	206	-8	80	8x7	77	50
0215, 0223	*PP*	225	197	6	90	12x9	76	66
	NP	223	195	3	100	12x9	76	66
	TT	216	214	-16	95	12x9	79	66
	SS1	214	209	-11	95	12x10	77	66
1002 HV, 1003 HV	*PP4*	214	172	-4	70	DN10	60	50

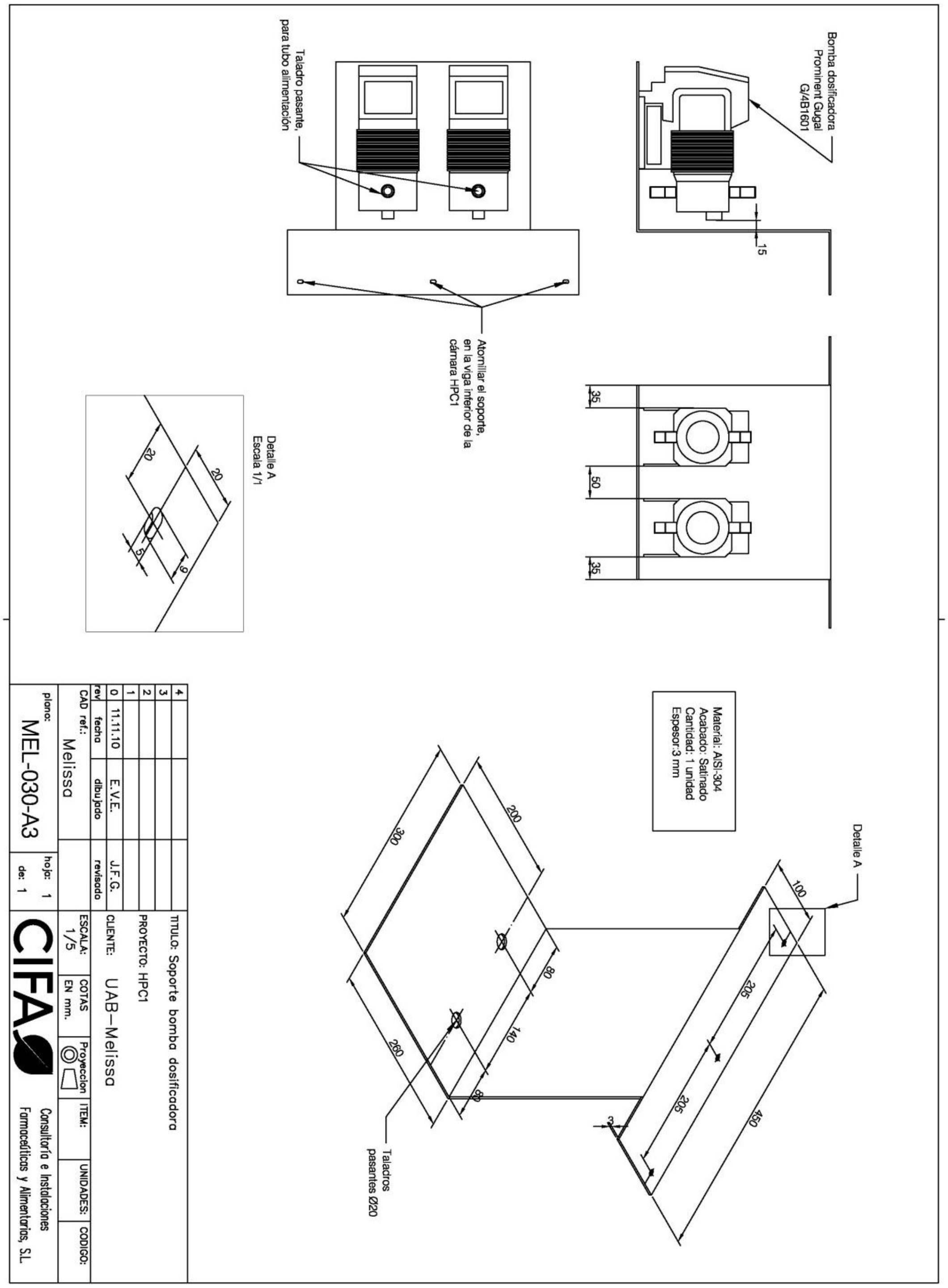
5 Comprobaciones en razón de la seguridad

Las bombas de la serie gamma llevan el símbolo CE que certifica que cumplen las normas CE indicadas en la declaración de conformidad.

Certificado de aptitud – Aparatos e instalaciones químicos

Homologación según ZH 1/109 (principios para la autorización de instalaciones cerradas de trasvase y dosificación), en combinación con el cabezal dosificador correspondiente.

Appendix 2: *Specification of metering pump support shelf*



Appendix 3: *Specification of pressure operated membrane-valves*

ITT

Pure-Flo®

Valve Bodies 2-Way

Engineered for life

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Pure-Flo Solutions Group has developed a line of valve bodies that help address the needs of the Bioprocessing and Pharmaceutical industries for high quality, welded process systems.

By providing valve bodies with controlled sulfur 316L/1.4435 stainless steel material and weld tangents long enough to accept the most common orbital weld heads in the industry, we have eliminated two of the most common concerns in valve-to-tube welding known today.

Automatic welding of 316L process components is greatly affected by the sulfur content of the mating process components. A disparity of sulfur content can result in reduced orbital weld quality and potentially incomplete fusion of the mating components. By controlling valve body sulfur content to the same chemistry as that required for ASME BPE fittings, welding problems due to material chemistry differences will be greatly reduced.

The Pure-Flo line of valve bodies fully complies with the controlled sulfur requirements for chemical composition of 316L/1.4435 material, set forth by the ASME Bioprocessing Equipment Standard 2002, Table DT-3.

By increasing the valve weld end tangent lengths to the values required for ASME BPE fittings (Table DT-4), we made the valve body compatible with virtually any orbital weld head utilized in the industry. Special offset or narrow heads are no longer required to weld a valve into a process system.

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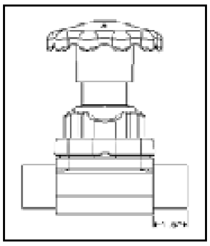
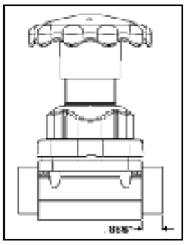
Controlled Sulfur Forging with Extended Weld Tangents

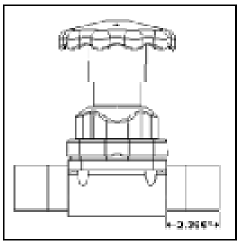
1.00" Valve Extended BW Forging (428L)



1.00" Valve Short Tangent BW Forging (428)



1.00" Valve Short Tangent w/ Tube Extensions (428 + TEB)



Size		Short Weld Tangent (428)	Extended Weld Tangent* (428L)	Short Over-All-Length (428)	Short Over-All-Length w/1.5" Tube Extensions (428 + TEB)	Extended Over-All-Length (428L)
IN	DN					
0.50"	DN15	0.748" (19)	1.50" (38)	3.50" (89)	6.50" (165)	5.12" (130)
0.75"	DN20	0.830" (21)	1.50" (38)	4.00" (102)	7.00" (178)	5.50" (140)
1.00"	DN25	0.866" (22)	1.50" (38)	4.50" (114)	7.50" (191)	5.88" (149)
1.50"	DN40	0.866" (22)	1.50" (38)	5.50" (140)	8.50" (216)	7.00" (178)
2.00"	DN50	0.984" (25)	1.50" (38)	6.25" (159)	9.25" (235)	7.62" (194)
2.50"	DN65	1.162" (29.5)	1.75" (44.5)[1]	8.75" (222)	11.75" (298)	10.00" (254)
3.00"	DN80	1.162" (29.5)	1.75" (44.5)	8.75" (222)	11.75" (298)	10.00" (254)
4.00"	DN100	1.250" (32)	2.00" (51)	11.50" (292)	14.50" (368)	13.00" (330)

*Meets or exceeds ASME BPE Table DT-4 for fitting weld tangents.
[1] Exceeds ASME BPE requirements.

2

316L Sulfur Controlled Chemistry per ASME BPE Table DT-3	
Element	**%**
Carbon (C)	0.035 max
Silicon (Si)	.75 max
Manganese (Mn)	2.0 max
Nickel (Ni)	10 - 15
Chromium (Cr)	16 - 18
Molybdenum (Mo)	2.0 - 3.0
Phosphorous (P)	0.04 max
Sulfur (S)	0.005-0.017 max

Fitting Weld Tangents per ASME BPE Table DT-4		
IN	DN	Size
0.5"	DN15	1.5" (38)
0.75"	DN20	1.5" (38)
1.0"	DN25	1.5" (38)
1.5"	DN40	1.5" (38)
2.0"	DN50	1.5" (38)
2.5"	DN65	1.5" (38)
3.0"	DN80	1.75" (44.5)
4.0"	DN100	2" (51)

Additional Benefits of the new Pure-Flo Body:

- No welded tube extensions required for most welding equipment
- Less over-all valve body length compared to welded tube extensions
- Fewer welds in the process system
- Less validation paperwork due to fewer material certifications
- Higher quality field welds
- No narrow or off-set weld heads required.

All these benefits add up to lower installation costs and improved production schedules.

End Connections

Pure-Flo Diaphragm Valve bodies are available in a variety of end connections:

- Tri-Clover Tri-Clamp®
- Cherry Burrell "S", "Q" and "I" line®
- 14, 16, 18, 20 O.D. Guage Tubing
- Schedule 5, 10, 40 Piping
- ISO Ends
- SMS 1146 Ends
- DIN 11850 Ends

3

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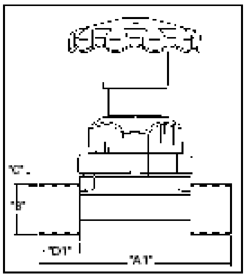
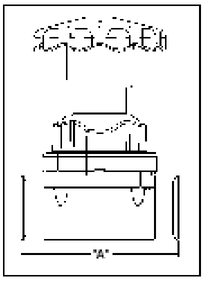
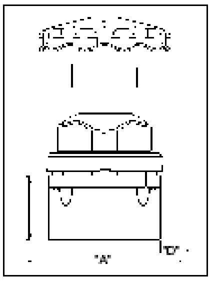
Body Dimension Charts







Body Dimension Charts US & SMS											
USOD (ANSI) Forgings & Castings										SMS	
B		A	D	A1	D1	C				B	C
End Connection Size		Overall Length	Weld Tangent	Overall Length	Weld Tangent	20 GA. 0.035"	18 GA. 0.049"	16 GA. 0.065"	14 GA. 0.083"		
IN	DN	Tri Clamp, TC x BW, Short Tangent BW	Short Tangent BW, TC x BW	Extended BW Forging	Extended BW Forging	Extended BW Forging	Extended BW Forging	Extended BW Forging	Extended BW Forging	BW Forging	BW Forging
Forgings											
BT 1/4"	DN6	3.5" (89)**	1" (25)**	N/A	N/A	S	O				
BT 3/8"	DN10	3.5" (89)**	1" (25)**	N/A	N/A	S	O				
BT 1/2"	DN15	3.5" (89)**	1" (25)**	N/A	N/A		O	S			
1/2"	DN15	3.5" (89)	0.748" (19)	5.12"(130)	1.5" (38)	O	O	S	O		
3/4"	DN20	4" (102)	0.83" (21)	5.5" (140)	1.5" (38)	O	O	S	O		
1"	DN25	4.5" (114)	0.866" (22)	5.88" (149)	1.5" (38)		O	S	O	(25)	(1.2)
1.5"	DN40	5.5" (140)	0.866" (22)	7" (178)	1.5" (38)		O	S	O	(38)	(1.2)
2"	DN50	6.25" (159)	0.984" (25)	7.62" (194)	1.5" (38)			S	O	(51)	(1.2)
2.5" *	DN65	8.75" (222)	1.162" (29.5)	10" (254)	1.75" (44.5)			S		(63.5)	(1.6)
3"	DN80	8.75" (222)	1.162" (29.5)	10" (254)	1.75" (44.5)			S	O	(76.1)	(2)
4"	DN100	11.5" (292)	1.25" (32)	13" (330)	2.0" (51)			O	S		
Castings											
1/2"	DN15	3.5" (89)	0.5" (13)	N/A	N/A	O	O	S	O		
3/4"	DN20	4" (102)	0.5" (13)	N/A	N/A	O	O	S	O		
1"	DN25	4.5" (114)	0.5" (13)	N/A	N/A		O	S	O	(25)	(1.2)
1.5"	DN40	5.5" (140)	0.5" (13)	N/A	N/A		O	S	O	(38)	(1.2)
2"	DN50	6.25" (159)	0.5" (13)	N/A	N/A			S	O	(51)	(1.2)
2.5"	DN65	7.62" (194)	0.5" (13)	N/A	N/A			S	O	(63.5)	(1.6)
3"	DN80	8.75" (222)	0.62" (16)	N/A	N/A			S	O	(76.1)	(2)
4"	DN100	11.5" (292)	0.62" (16)	N/A	N/A			O	S		

* 2.5" size uses 3"topworks
**BT TC x BW and TC x TC bodies are 2.5" (64) overall length with 0.5" (13) tangent
Note: Extended Weld Tangents are available only with USOD (ANSI) end connections
Dimensions in ( ) are mm; S = Standard; O = Optional; BT = Bio-Tek Body

ISO/DIN Castings & Forgings																	
ISO												DIN Series 1		DIN Series 2		DIN Series 3	
End Connection Size DN	Topworks Size	A	D	B	C							B	C	B	C	B	C
		mm	mm	mm	1	1.2	1.6	2	2.3	2.6	2.9	mm	mm	mm	mm	mm	mm
DN6	BIOTEK	89	25	8	S	O						8	1				
DN10	BIOTEK	89	25	13.5	O		S	O				10	1				
DN15	BIOTEK	89	25	17.2	O		S	O				12	1	13	1.5	14	2
DN15	1/2"	106	25	21.3			S	O				18	1	19	1.5	20	2
DN20	3/4"	118	25	26.9			S	O				22	1	23	1.5	24	2
DN25	1"	127	25	33.7			O	S				28	1	29	1.5	30	2
DN40	1 1/2"	174	35	48.3			O	S				40	1	41	1.5	42	2
DN50	2"	191	35	60.3				S	O	O	Cast Only	52	1	53	1.5	54	2
DN65	3"	229	35	76.1				O	S	O		70	2				
DN80	3"	229	35	88.9					S	O		85	2				
DN100	4"	292	31	114.3					S	O		104	2				

Note: All measurements are mm unless otherwise noted.
S = Standard; O = Optional

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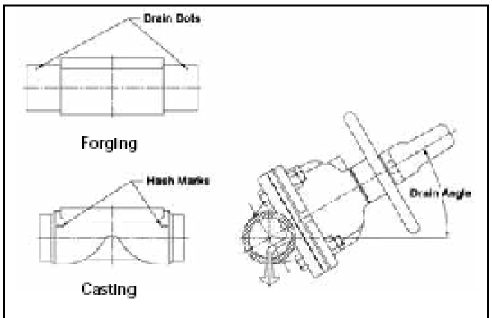
Drain Angles						
Valve Size		Forging	Forging		Investment Casting	
Inch	DN	ANSI	ISO	DIN	ANSI	ISO
1/4, 3/8, 1/2[1]	6, 10, 15[1]	30°/20°[2]	20°	20°	N/A	N/A
0.50	15	30°	13°	16°	30°	17°
0.75	20	30°	21°	25°	30°	18°
1.00	25	30°	22°	26°	31°	20°
1.50	40	28°	17°	22°	30°	20°
2.00	50	23°	16°	19°	25°	19°
2.50	65[5]	26°[3,6]	23°	23°	19°	N/A
3.00	80[5]	20°[6]	14°	18°	25°	N/A
4.00[4]	100[5]	16°	11°	14°	20°	N/A
6.00	150	N/A	N/A	N/A	20°	N/A

[1] Bio-Tek sizes.
[2] 20° is drain angle for the Bio-Tek buttweld bodies with 1" (25.4 mm) cut-backs. 30° is drain angle for Bio-Tek TC bodies. Consult engineering drawings for drain angles on Bio-Tek fabrications.
[3] 3" forge body with 2 1/2" end connection.
[4] 4" ANSI body is wrought/forgings to be available 8/04.
[5] DIN 65, 80, 100 bodies to DIN/ISO dimensions are wrought.
[6] Drain angles for 2.5" and 3.00" Extended tangent forgings have not been determined. Contact factory for details.
Note: As a rule of thumb drain angle tolerances of +/- 2° will assure optimal drainability. Consult Pure-Flo product engineering for specific drain angle tolerances.



Drainability
Drain marks are provided as standard on cast and forged bodies to facilitate installation and optimize drainability. One mark must be located in the vertical plane, cutting the centerline of the pipe.

The slope of process piping must be designed to provide proper pitch in order to optimize drainability. Drainability in a process system is ultimately the responsibility of the system designer end user.

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Metallurgy

Pure-Flo Solutions Group customers have a choice of valve body types based on the needs and requirements of the process application. Pure-Flo standard body material for forged bodies is 316L,1.4435 sulfur controlled to ASME BPE 2002 Table DT-3.

Wrought bodies are available in 316L,1.4435 or other special materials. Biopharmaceutical applications may require special alloys or materials to provide a desired performance. Consult a Pure-Flo Solutions Group representative for availability and application information.

All valve bodies are fully material heat traceable to EN 10204 3.1B. Certified Mill Test Reports are provided as standard.

Surface Finish

Pure-Flo valve bodies are available in a complete range of mechanically polished and electropolished internal surface finishes to satisfy system design requirements.

Pure-Flo valves are available in a complete range of ASME BPE compliant internal surface finishes.

Pure-Flo Solutions Group provides a complete range of both internal and external electropolish options. Electropolish surface finishing creates a superior surface finish for biopharmaceutical applications. Electopolishing improves corrosion resistance, removes inclusions and contaminants, and improves the over-all surface for cleaning and sterilization.

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Metallurgy

		Forged	Wrought	Cast
Size Range	ANSI	1/2" - 4"	1/2" - 6"	1/2" - 6"
	DIN/ISO	DN 15 - DN50	DN 15 - DN150	DN 15 - DN50
316L Stainless Alloy		Tri Certified to ASTM A182 Grade 316L,SQ, DIN 17440, 1.4435, BN2	ASTM A479, A240, 316L DIN 17440, 1.4435, BN2	ASTM A351 Grade CF 3M
Special Alloys*			C22, C276, AL6XN	
Dimensional Standards		USOD Tubing, Pipe, ISO/DIN/SMS	USOD Tubing, Pipe, ISO/DIN	USOD Tubing, Pipe, ISO/DIN
Ferrite content		< 0.5%	< 3%	<12%

* other materials available upon request

Surface Finish

Mechanical Polish Surface Finish (Interior Only)		
Code	Non-EU Service Microinch Max	EU Service Micron Max
0	NO MECHANICAL POLISH	NO MECHANICAL POLISH
2	35 Ra	0.8 Ra
6	25 Ra	0.6 Ra
8	20 Ra	0.5 Ra
7	15 Ra	0.4 Ra
9	11 Ra	0.3 Ra

Electropolish Surface Finish (Interior & Exterior)	
Code	
0	NO ELECTROPOLISH
2	EXTERIOR ELECTROPOLISH ONLY
3	BOTH INTERIOR AND EXTERIOR ELECTROPOLISH
4	INTERIOR ELECTROPOLISH ONLY

Surface Finishes per ASME BPE 2002*	
Code	Mechanical Polished Surface Finish (Interior Only)
	Microinch MAX
SFV1	20 Ra
SFV2	25 Ra
SFV3	30 Ra
	Mechanical Polished & Electropolished Surface Finish (Interior Only)
	Microinch MAX
SFV4	15 Ra
SFV5	20 Ra
SFV6	25 Ra

*ASME BPE 2002 Addenda 2004

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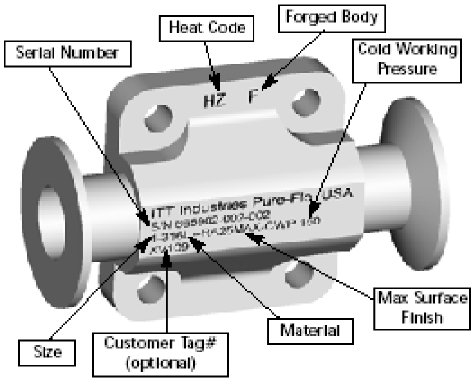
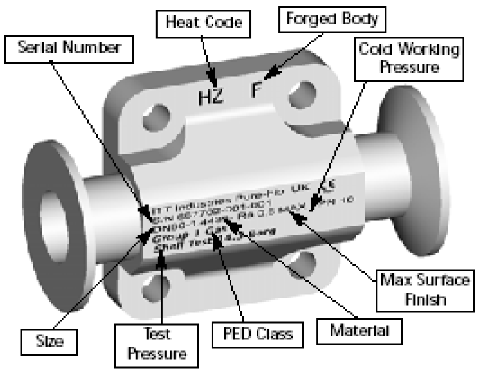
Marking



Marking for European Union Service



Pure-Flo valves comply with the European Union (EU) Pressure Equipment Directive (PED) 97/23/EC Category 1.
Valve bodies are CE marked per the 97/23/EC when EU service is requested.

Validation
Pure-Flo Solutions Group provides critical validation information to meet the needs of the Pharmaceutical and Bioprocessing industries.

Marking
Pure-Flo valve bodies are marked directly on the valve body, typically on the bottom of the valve or underside of the bonnet flange. Separate, attached stainless steel tags have been eliminated, where possible, except for limited cases such as special marking requirements and fabrications that prohibit direct body marking. Additional information such as customer tag number is available upon request.

Certified Mill Tests Reports
All Pure-Flo Valve bodies contain a heat number traceable per EN 10204 3.1B. Certified Mill Test Reports (CMTRS) are provided as standard on all Pure-Flo valves.

Certificate of Compliance to Specifications
A Certificate of Compliance to customer specification is provided as a standard on all Pure-Flo valves.

Additional Validation information available on request

- Interior Surface Characterization documentation
- Certification of compliance to CFR Title #21 section 177
- Certification to USP XXIII Class VI compliance and/or physical testing document
- Quality assurance manual
- ISO 9001 certification
- Certification of testing to MSS-SP-88

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PFVBA4-06

For more information, please contact:

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Phone +1 (717) 509-2200
Fax +1 (800) 239-9402

Website: www.ittpureflo.com
E-mail: pureflo.custserv@itt.com

Valve Office Locations:

Pure-Flo
110-B West Cochran
Simi Valley, CA 93065 USA
Phone +1 (800) 926-8884
Phone +1 (805) 520-7200
Fax +1 (805) 520-7205

Pure-Flo
Richards Street
Kirkham, Lancashire
PR4 2HU, England
Phone +44-1772-682696
Fax +44-1772-686006

ITT

8H.POD

8

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General Engineering

Engineered for life

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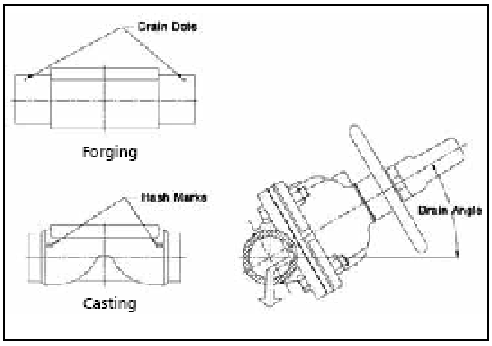

Drain Angles						
Valve Size		Forging	Forging		Investment Casting	
Inch	DN	ANSI	ISO	DIN	ANSI	ISO
1/4,3/8,1/2[1]	6,10,15[1]	30°/20°[2]	20°	20°	N/A	N/A
0.50	15	30°	13°	16°	30°	17°
0.75	20	30°	21°	25°	30°	18°
1.00	25	30°	22°	26°	31°	20°
1.50	40	28°	17°	22°	30°	20°
2.00	50	23°	16°	19°	25°	19°
2.50	65[5]	26°[3]	23°	23°	19°	N/A
3.00	80[5]	20°	14°	18°	25°	N/A
4.00[4]	100[5]	16°	11°	14°	20°	N/A
6.00	150	N/A	N/A	N/A	20°	N/A

[1] Bio-Tek sizes.
[2] 20° is drain angle for the Bio-Tek buttweld bodies with 1" (25.4 mm) cutbacks. 30° is drain angle for Bio-Tek TC bodies. Consult engineering drawings for drain angles on Bio-Tek fabrications.
[3] 3" forge body with 2 1/2" end connection.
[4] 4" ANSI body is wrought/forgings to be available 8/04.
[5] DN 65, 80, 100 bodies to DIN/ISO dimensions are wrought.
Note: As a rule of thumb drain angle tolerances of +/- 2° will assure optimal drainability. Consult Pure-Flo product engineering for specific drain angle tolerances.

Valve Stroke

Valve Size	Approx. Stroke
Bio-Tek	0.16"
0.50"	0.25"
DN 15	6.3 mm
0.75"	0.38"
DN 20	9.6 mm
1.00"	0.50"
DN 25	12.7 mm
1.50"	0.81"
DN 40	20.6 mm
2.00"	1.12"
DN 50	28.4 mm
3.00"	1.62"
DN 80	41.3 mm
4.00"	2.12"
DN 100	53.8 mm

3

Installation

Position of Drainability
Pure-Flo diaphragm valves may be installed in vertical or horizontal lines as required. To optimize drainability in a horizontal line, hash marks are provided on the casting and drain dots on the forging to orient the valve at the proper angle during installation. This feature helps assure that the valve is positioned to optimize drainability. One hash mark must be in a plane cutting the vertical centerline of the pipe.

The slope of process piping must be designed to provide proper pitch in order to optimize drainability. Drainability in a process system is ultimately the responsibility of the system designer and/or end user.

Weld Installation
Bio-Tek Valves, 1/4"–1/2" (DN 8–15) and ISO End valves have minimum 1" (25 mm) cutbacks* and generally do not require tube extensions for standard TIG orbital welding equipment.

Pure-Flo valves, 1/2"–6" (DN 15–150) have ASME BPE fitting compatible outbacks and generally can be welded without disassembly using most standard TIG orbital welding equipment.*

As an added safety precaution, a 350°F (176°C) tempilstick should be placed on the body bonnet flange adjacent to the weld if excessive heat transfer is expected. The bonnet area should be kept at or below 350°F (176°C).[1]

[1] For Thermoplastic PAS and 950 Bonnets, the bonnet area should not exceed 300°F (149°C).

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C_V/K_V Data for Standard 2 Way Valve

Valve Size	C_V/K_V Ratings for Stainless Steel Pure-Flo Diaphragm Valves															
Inch/DN	0.50"	15	0.75"	20	1.00"	25	1.50"	40	2.00"	50	2.5"	65	3.00"	80	4.00"*	100*
% Open	C_V	K_V	C_V	K_V	C_V	K_V	C_V	K_V	C_V	K_V	C_V	K_V	C_V	K_V	C_V	K_V
10	0.2	0.05	2.0	0.48	3.0	0.72	9	2.16	12	2.88	20	4.08	30	7.20	32	7.68
20	0.4	0.10	3.1	0.74	6.0	1.44	16	3.84	26	6.24	37	8.88	55	13.20	70	16.80
30	0.7	0.17	4.5	1.08	8.0	1.92	24	5.76	39	9.36	52	12.48	85	20.40	130	31.20
40	1.2	0.29	5.5	1.32	10.0	2.40	30	7.20	49	11.76	65	15.60	115	27.60	200	48.00
50	1.5	0.36	6.0	1.44	13.0	3.12	36	8.64	56	13.44	75	18.00	135	32.40	265	63.60
60	2.0	0.48	6.4	1.54	14.0	3.36	40	9.60	62	14.88	83	19.92	155	37.20	290	69.60
70	2.4	0.58	6.8	1.63	16.0	3.84	44	10.56	66	15.84	89	21.36	165	39.60	320	76.80
80	2.8	0.67	7.0	1.68	17.0	4.08	47	11.28	69	16.56	94	22.56	170	40.80	360	86.40
90	3.0	0.72	7.2	1.73	18.0	4.32	48	11.52	70	16.80	95	22.80	175	42.00	385	92.40
100	3.5	0.84	7.5	1.80	19.0	4.46	48	11.52	70	16.80	95	22.80	180	43.20	400	96.00

Note: C_V Values expressed in GPM per one psi pressure drop. K_V Values expressed in liters/second per one bar pressure drop.
3. See page 57 for Bio-Tek C_V ratings.
*C_V (K_V) for 4" (DN 100) valve full open with Advantage Actuator is 340 (86,36).

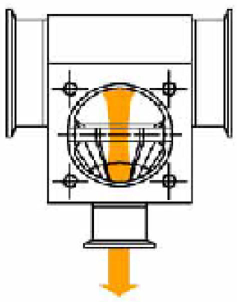
Zerostatic Block Body T Flow Reduction
Estimate of Reduction of Cv (Standard 2 Way Valve Baseline)
(% Reduction)

Valve Size / Run Size	BT 0.5" DN15	0.5" DN15	0.75" DN 20	1" DN 25	1.5" DN 40	2" DN 50
0.5" (DN 15)	15.2	18.0	NA	NA	NA	NA
0.75" (DN 20)	14.5	17.2	16.2	NA	NA	NA
1" (DN 25)	13.8	16.3	15.4	23.5	NA	NA
1.5" (DN 40)	13.1	15.5	14.6	22.3	25.5	NA
2" (DN 50)	12.4	14.6	13.8	21.0	24.1	19.0
2.5" (DN 65)	12.0	14.1	13.4	20.3	23.3	18.4
3" (DN 80)	12.0	14.1	13.4	20.3	23.3	18.4
4" (DN 100)	11.6	13.7	12.9	19.7	22.6	17.8

Notes:
Consider entrance loss (at valve inlet) is similar to flow thru branch of standard tee.

Example
1.5" (DN40) Zero Static Tee with 3" (DN80) Run

Approximate 100% open Cv =
48 - (23.3%) (48) = 36.8 Cv
= 8.84 Kv



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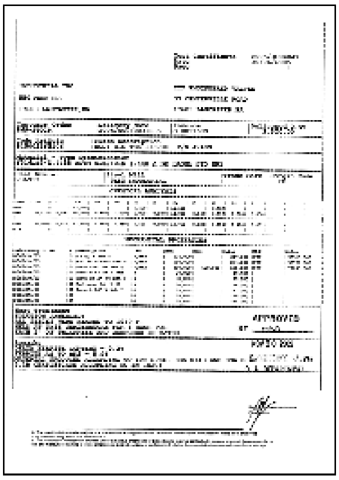


CERTIFICATE OF COMPLIANCE

Validation and Qualification Documentation

Pure-Flo can provide the following documentation to aid the validation and qualification process upon request.

Process Validation Documentation

- Certified Mill Test Reports
- Interior Surface Characterization
- Certification of compliance to specifications
- Certification of compliance to CFR Title #21 section 177
- Certification to USP XXVIII Class VI compliance
- Quality assurance manual
- ISO 9001 certification
- Certification of testing to MSS SP-88

Qualification Assistance

To assist you in compliance to IQs, OQs and PQs, a preventative maintenance program can be established for the changeout of diaphragms based on your passivation, cleaning, sterilization and process protocols.

Approvals

Pure-Flo diaphragm valves are available to meet a variety of industry standards.

3A Service
Selection from the following configurations is necessary to assure 3A conformance:

Body:
- 316L stainless steel investment casting or forging
- Sizes 1/2"–6" (DN15–150).

Interior Polishes:
- 35 μin (,89 μm) - 11 μin (,28 μm)
- Electropolish exterior (optional)

End Connections:
- Quick disconnect end connections
- Buttweld (16 gauge tubing)

Diaphragms:
- Class I Applications
  TM17 PTFE
- Class III Applications
  Grade P Buna N
  Grade17 EPDM

Bonnet/Actuator:
- Stainless steel bonnets
- Cast iron bonnets (PVDF coated)
- Ductile iron bonnets (PVDF coated)
- Finishes per ACI surface inidcator scale SIS-3
- "W4" Weep holes (4) 3/32" (2,4 mm) dia. holes 90° apart
- Stainless bolts or studs food grade lubricants

Bonnet internals:
- Stainless steel bushing
- Stainless steel stem
- Stainless steel fingerplate (where applicable)
- PVDF coated compressor

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970 Stainless Steel Manual Bonnet

Stainless Steel Bonnet (31)

7

Stainless Steel Valve Bodies

Grade TM17 PTFE and Grade 17 EPDM Diaphragms

USDA Accepted
The Pure-Flo diaphragm valve is accepted by the USDA for use in federally inspected meat and poultry plants.

Selection from the following configurations is necessary to assure USDA acceptance.

Body:
- 316L casting
- 316L forging
- Sizes: 1/2"–6" (DN15–150)

Interior Polishes:
- 35 µin (,89 µm) - 11 µin (,28 µm)
- Electropolish exterior (optional)

End Connections:
- Tri-Clover Tri-Clamp
- Cherry Burrell "S", "Q", and "I" line, male sanitary thread

Diaphragms:
- Black Butyl
- Buna N
- EPDM
- PTFE

Bonnets:
- White epoxy
- PVDF coatings
- Stainless steel

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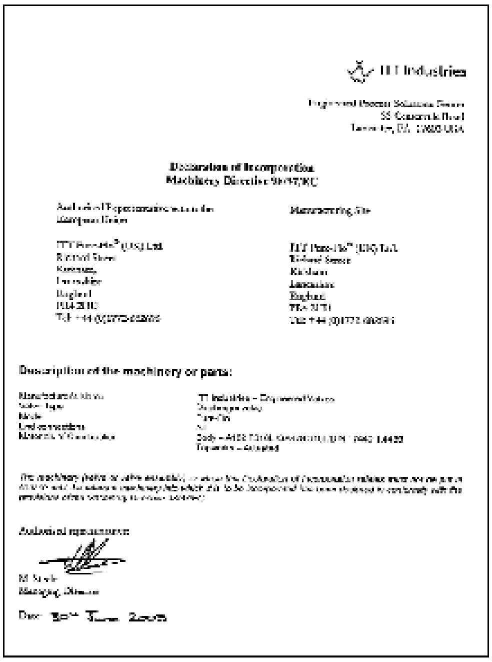

ITT Industries

Declaration of Incorporation
Machinery Directive 98/37/EC

Description of the machinery or parts:

Authorised representative:

European Union Directives (cont.)

EMC - Electromagnetic Compatibility Directive 89/336/EEC

The EMC Directive covers any apparatus liable to cause electromagnetic disturbance or can be affected by such disturbance.

Included Apparatus:

- Solenoid valves
- Proximity switches
- Electro Pnuematic positioners
- Electro Pnuematic transducers

Excluded Apparatus:

- Limit switches
- "CE" Marked

LVD - Low Voltage Directive 73/23/EEC

- Electrical equipment rated between 50 - 1000 VAC, 75-1500 VDC
- EC Declaration of Conformity required
- "CE" marked

Safety of Machinery Directive 98/37/EC

- An assembly of linked parts or components, at least one of which that moves
- Actuated valves are considered components and therefore require a Declaration of Incorporation
- Manual valves are excluded from this directive

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ATEX Directive 94/9/EC

- Institutes uniform controls on equipment intended for use in potentially explosive atmospheres (PEAs) within the EU and European Economic Area (EEA)
- Compliance mandatory on July 1, 2003 - All equipment intended for use in potentially explosive atmospheres, defined as machines, apparatus, fixed or mobile devices, control components and instrumentation which, separately or jointly, are capable of causing an explosion through their own potential sources of ignition.
- Facility owners must classify potentially explosive atmospheres into Zones
- Products must be classified into Equipment Groups and Categories
- Pure-Flo valves are Equipment Group II products
  - Zone 0 environments require Category 1 hardware
  - Zone 1 environments require Category 1 or 2 hardware
  - Zone 2 environments require Category 1, 2, or 3 hardware
  - A facility must specify whether the hazard present is due to gas or dust. The ATEX Directive treats these hazards differently and outlines different methods of protection
  - An equipment manufacturer must provide
    - ambient temperature range
    - maximum surface temperature
- All products must be assessed as a system. The compliance of individual components is not sufficient justification for deeming the assembly as ATEX approved.
- All ATEX approved products must bear a CE mark
- A Declaration of Conformity and Instructions for Safe Use are supplied as required
- Manufacturers and Users are responsible for compliance

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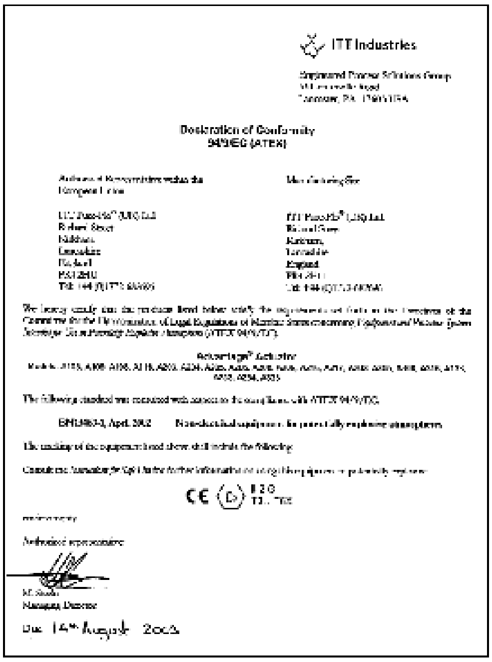

ITT Industries

Declaration of Conformity
94/9/EC (ATEX)

Appendix 4: *Specifications for nursery components*

Get growing with Grostart

It's easy to grow your own. All you need is the right equipment, a little knowledge and of course time... nature can be relied upon to do the rest.

The Sankey Grostart Propagator is the first step in eating your own vegetables or growing your own plants. There's nothing like seeing a fully grown plant that you've nurtered from seed take pride of place in your garden or allotment.

The Grostart Propagator is part of Sankey's extensive range of heated and unheated propagators. Like all of Sankey's products, it has been designed to be used over and over again. In line with Sankey's ethical ethos, the Grostart Propagator is made with recycled materials wherever possible.

PROPAGATION

Propagators, Trays and Accessories

Growing your own fruit and vegetables is practical, fun and can provide fresh vegetables and colour all year round. With rising food and fuel prices, there's never been a better time to grow your own.

Our range of eco-friendly, recyclable, practical gardening solutions are ideal, whether your customers are seasoned professionals or a novice gardener just starting out we've got it covered.

1 Slim Space Saving Water Butt 1042
2 Slim Water Butt Stand 1056
3 Twist-it Watering Can 1043
4 Florence Trough - sandstone 1484
5 Ecomax Compost Bin 4169
6 Workbench 7116
7 Various Grow Pots 0100 - 0104, 0107, 0110 - 0114, 0116
8 Grapes 0525
9 Garden Sieve 1238
10 Garden Tray 1582
11 Grostart Propagator 1590
12 Tuscan Round Pot - green 5485
13 Bell Trough - green 4874

NEW

Green

Premium Deep Root Propagator

Product Code	Dimensions cm	Quantity Per Outer
4195	L52 x W42 x H27	4

Green

Grostart Propagator

Product Code	Dimensions cm	Quantity Per Outer
1588	L21 x W17.5 x H13	10
1589	L38 x W24 x H19	6
1590	L52 x W42 x H23	4

All Sankey propagator packaging is made from 95% recycled material and is 100% recyclable.

Green

Growarm 100 Propagator

8 WATT HEATED

Product Code	Dimensions cm	Quantity Per Outer
1597	L38 x W24 x H19	1
1598	L38 x W24 x H19	42

Kit includes:
- 2 x 21cm seed trays
- Capillary mat
- Instruction booklet

Green

Growarm 300 Propagator

18 WATT HEATED

Product Code	Dimensions cm	Quantity Per Outer
1599	L52 x W42 x H24	1
1600	L52 x W42 x H24	28

Kit includes:
- 1 x 38cm seed tray
- 2 x 21cm seed trays
- 5 x 9cm dwarf pots
- Instruction booklet

Green

Plantmaster 2000 Propagator

40 WATT HEATED

Product Code	Dimensions cm	Quantity Per Outer
1011	L57 x W38 x H25	1

Kit includes:
- 3 x seed trays
- Capillary mat
- 5 x flower pots
- Instruction booklet

Heated propagators produce ideal conditions for growing cuttings and seedlings.

TOP TIP

Our products are made in the UK and have a low carbon footprint

SANKEY GARDEN PRODUCTS GROWING WITH YOU

28 Tel: +44 (0)115 927 7335 Email: info@rsankey.co.uk www.rsankey.com 29

Latest news

Categories: » Propagation Products » Propagators

Other views:

Growarm 300

An 18 watt heated propagator complete with starter kit. Ideal for growing your own seeds, cuttings and vegetables which require a higher and/or constant climate.

- Provides controlled heat for growing seeds and cuttings
- Rigid clear top
- Adjustable ventilation to control air flow
- 3 metre cable and 13 amp fitted plug

Kit Includes:

- 3 x 22cm seed trays
- Capillary matting
- 5 x 9cm flower pots
- Instruction booklet

Product Code:
1599

Product Area:
Heated Propagators

Main Cat:
» Propagation Products

Sub Cat:
» Propagators

Material:
Top - General Purpose Polypropylene Base - High Impact Polystyrene

Colours in this range:
● Green

Growarm 300 - Product Details

Colour	Product Code	Barcode Suffix	Ø Dia	Height	Length	Width	Qty per Outer
●	1600	10081	24	52	42	28	
●	1599	10081	L 52cm	26cm	42cm	1	

Agrolite
ILUMINACIÓN PARA SU CULTIVO
MENU
Plug & Play
HPS
HPS Duplo
UFO
MH
DarkNight
CFL
FAQs
Contacto
CFL
105W - 150W - 200W - 250W
Los fluorescentes compactos Agrolite están especialmente diseñados para dar un aporte suplementario de luz a sus plantas de interior. Dando un rendimiento 70-75 lúmenes por watio. Su balastro interno hace muy cómodo el uso del CFL, siendo innecesario cualquier tipo de instalación, enroscar y listo. Su bajo consumo y una vida útil de más de 8.000 horas hacen de Agrolite un producto muy económico. Notará el ahorro en su factura de la luz, además CFL apenas produce calor, resultando un producto muy seguro para los pequeños de la casa.
CFL está disponible en dos espectros:
-Azul (Para planta verde o en fase de crecimiento)
-Rojo (Para planta de flor o en fase de floración).

Appendix 5: *Air baffles for upper louvers experimental results*

1. *VELOCITY MAPPING OF BAFFLE PANELS CONFIGURATIONS*

In order to verify the impact of both baffles and louvers configurations into the air distribution, MPP decided to perform some tests to compare the results. There are three different baffle panels holes size to distribute the air, the L = large size, the M= medium size and the S = small size .The velocity mapping test used the Accu-track system (data acquisition system) to measure the air velocity, the humidity and the temperature inside the HPC1 chamber. The disposition of the probes in the tray is shown in the following drawing **(Fig 1.1).** The test was performed using the plexi-glass louvers ("RM plexi") configuration.

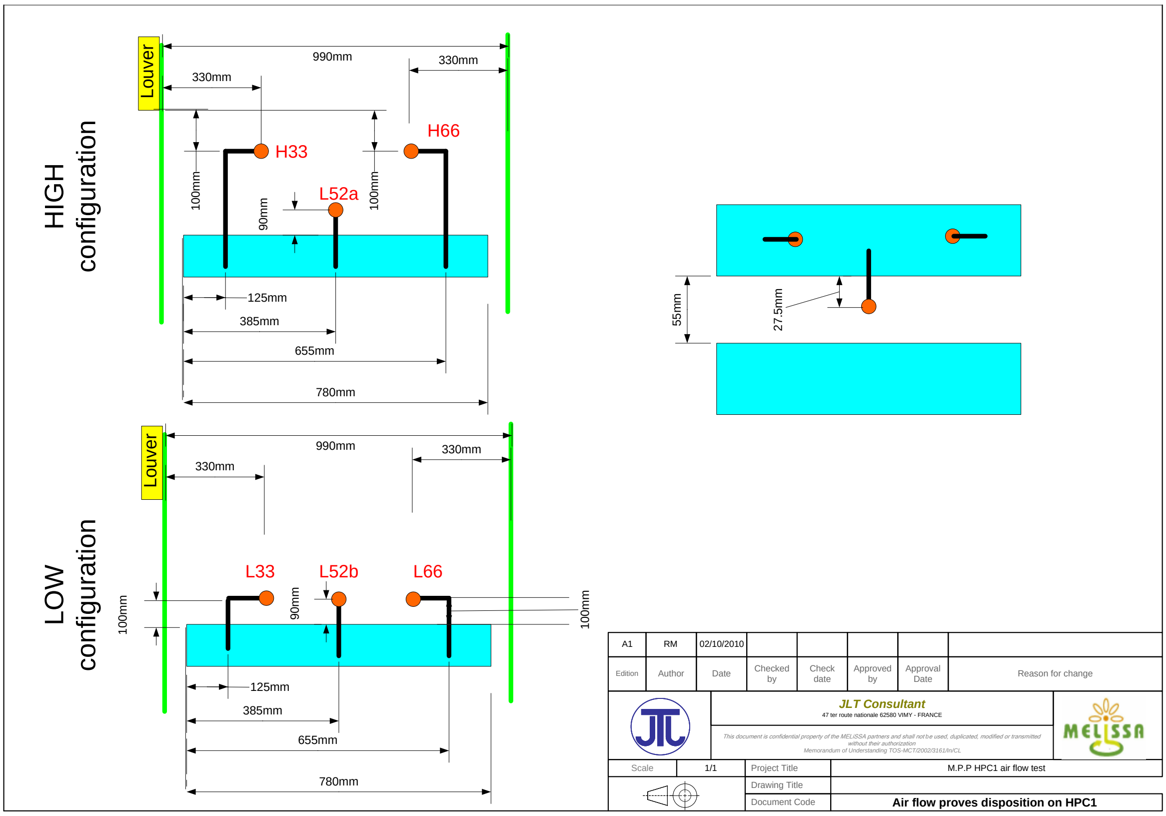


Fig 1.1

1.1.- *ANGSTROM CONFIGURATION:*

The ANGSTROM original configuration followed the next sequence of baffle panels distribution , starting in the airlock A: **L-M-S-S-S-M-L-L-L**

Results: To have a better vision of the air distribution, the graph is divided in two, high probes configuration results **(Fig 1.2)**, and low probes configuration results (**Fig 1.3).**

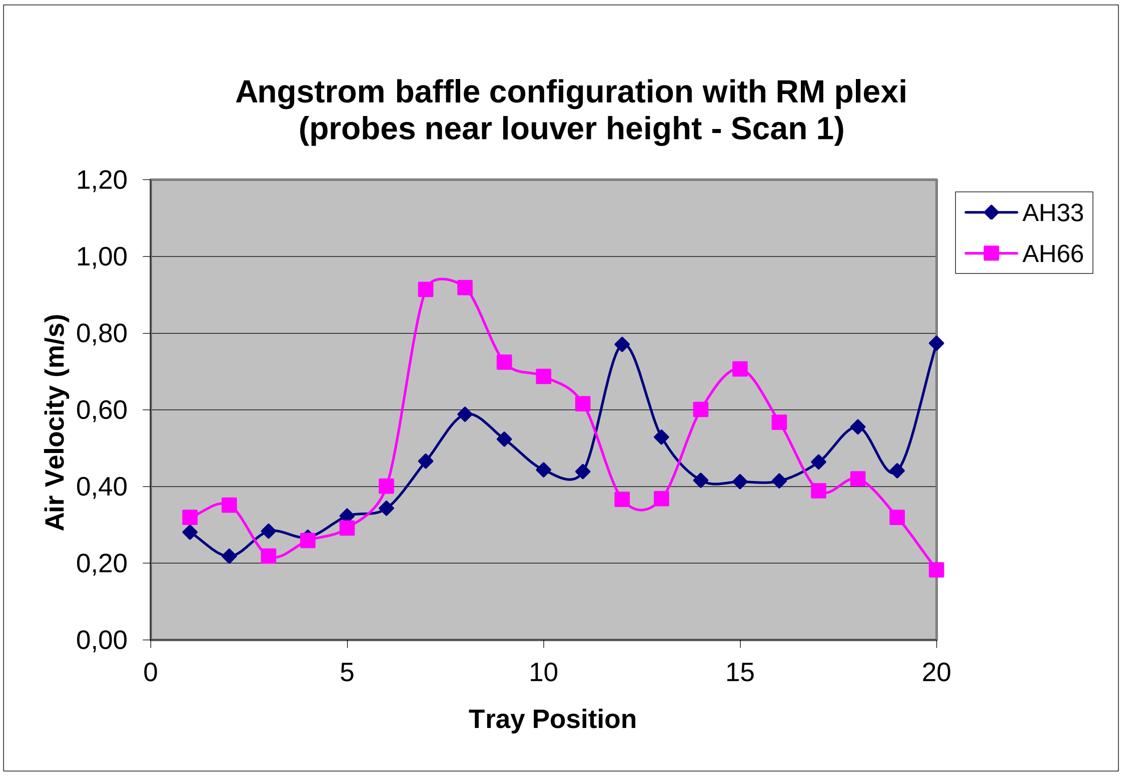

Angstrom baffle configuration with RM plexi
(probes near louver height - Scan 1)
Air Velocity (m/s)
Tray Position
AH33
AH66
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0
5
10
15
20

Fig 1.2

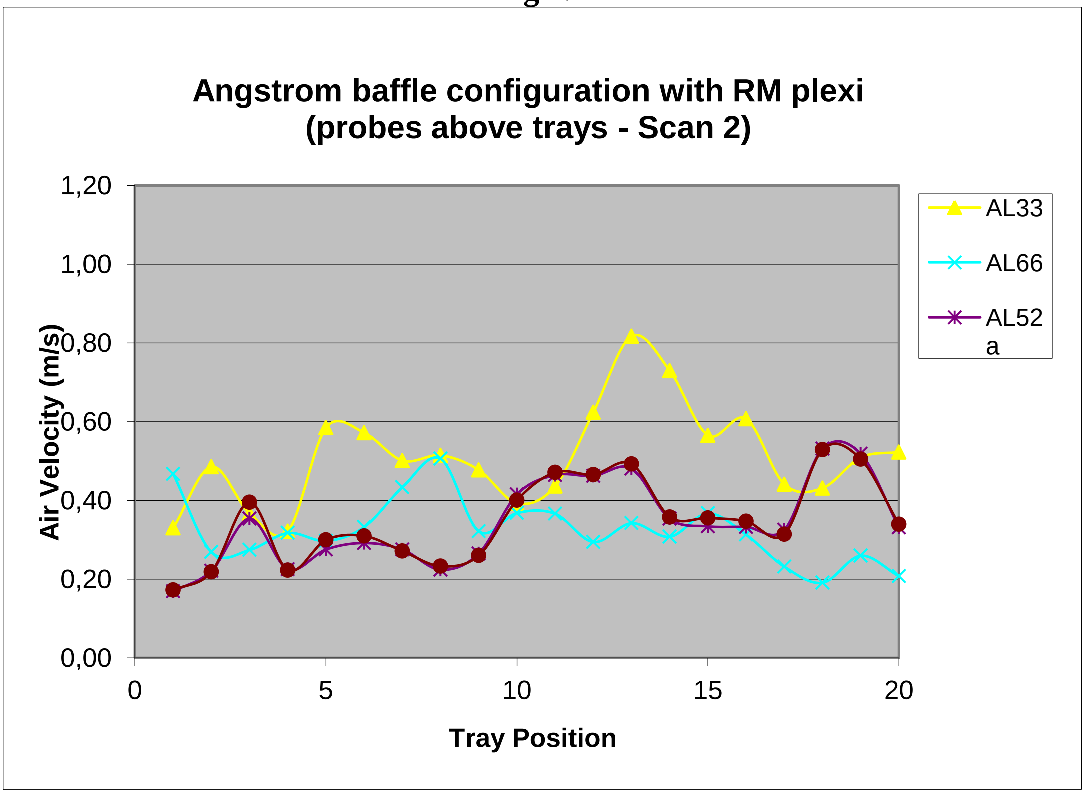

Angstrom baffle configuration with RM plexi
(probes above trays - Scan 2)
Air Velocity (m/s)
Tray Position
AL33
AL66
AL52
a
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0
5
10
15
20

Fig 1.3

1.2.- MPP CONFIGURATION:

The MPP configuration follow the next sequence of baffle panels distribution , starting in the airlock A: **L-S-M-L-S-L-M-S-L**

Results: To have a better vision of the air distribution the graph is divided in two, high probes configuration (**Fig 1.4)**, and low probes configuration (**Fig 1.5).**

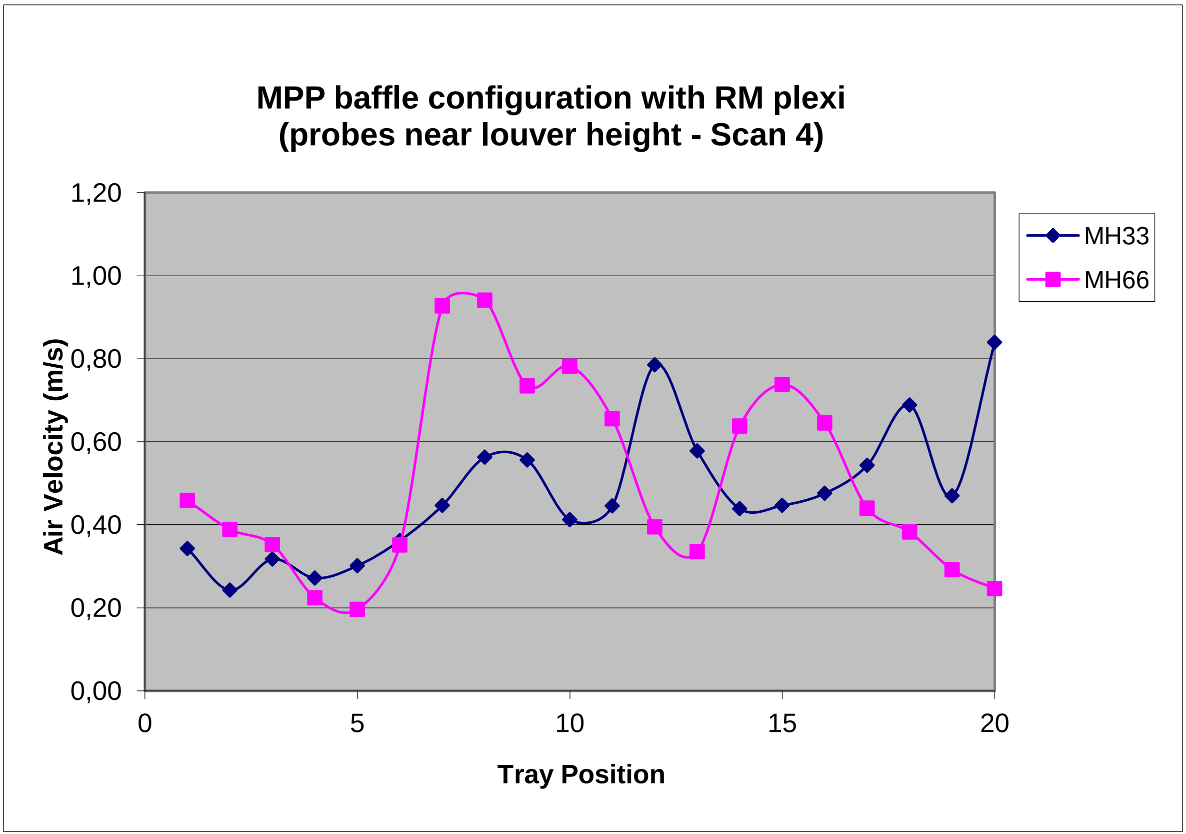


Fig 1.4

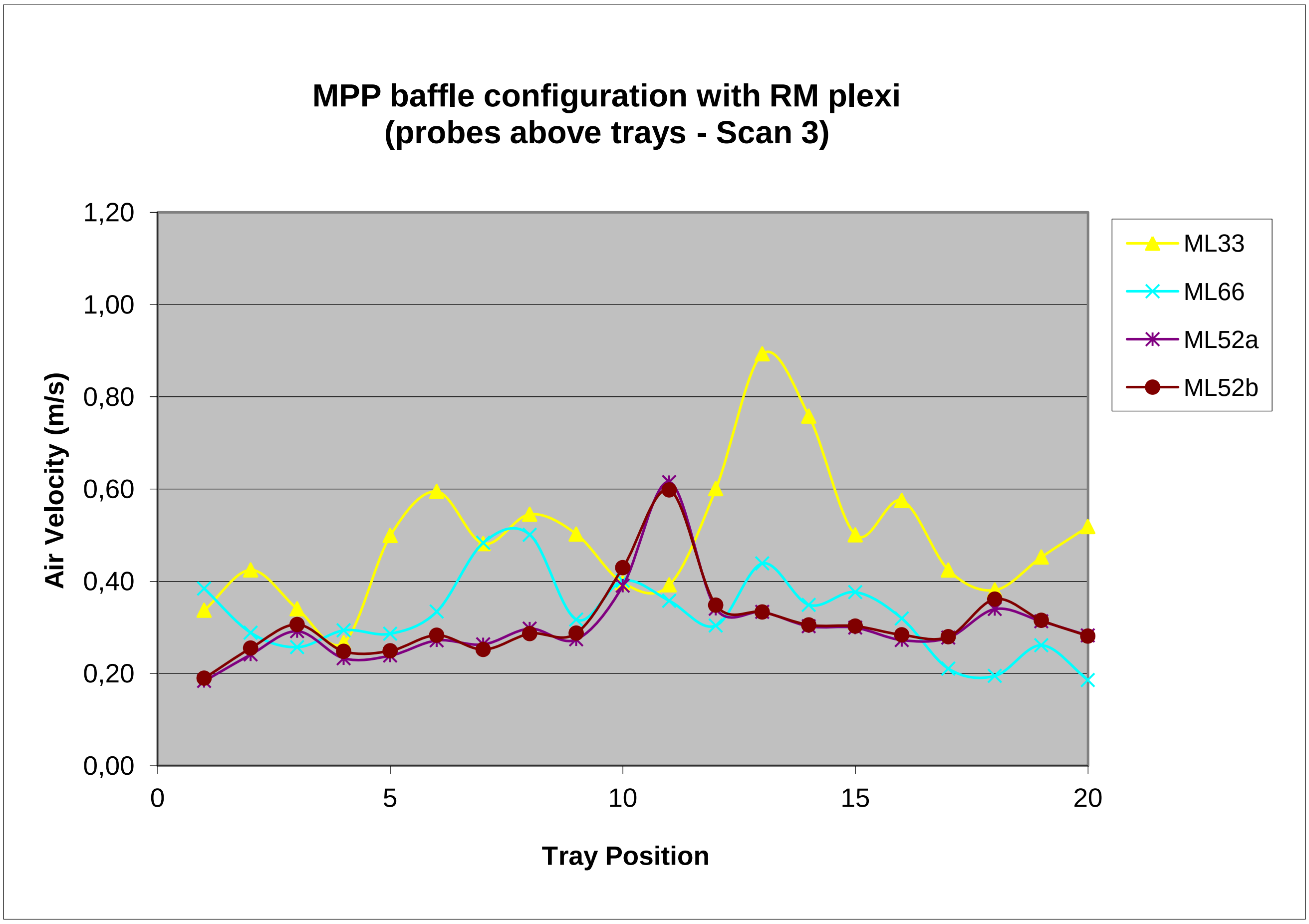


Fig 1.5

1.3.- CONCLUSIONS:

The impact of the different baffle configuration is not so strong on the dynamics of the airflow inside the HPC1 chamber. Both high probes disposition test (near louvers height) provide very similar results of air flow at the high level, but there are slight differences in the lower probes disposition (probes above the trays) test results.

The Angstrom configuration is a little bit more efficient, and have a more homogenous distribution of the air flow in the lower position. It is decided to select the Angstrom configuration attending the results.

2.- *VELOCITY MAPPING TO VERIFY THE PLASTIC SHEETS IMPACT*

In order to verify the impact of the plastic sheet disposition (used to cover the trays in order to decrease the proliferation of algae) into the air distribution, MPP decided to perform some test to compare the results. This test was performed using the same probes disposition and the same Accu-track system used in the previous test.
The test was performed using the plexi-glass louvers configuration, and the MPP baffle configuration.

2.1.- TEST WITHOUT PLASTIC SHEETS:

The test was performed without any plastic sheet. The space between the trays is free and the airflow pass through the space going directly to the HPC1 bottom part.
Results: To have a better vision of the air distribution, the graph is divided in two, results of high configuration of probes (**Fig 2.1)**, and results of low configuration of probes (**Fig 2.2).**

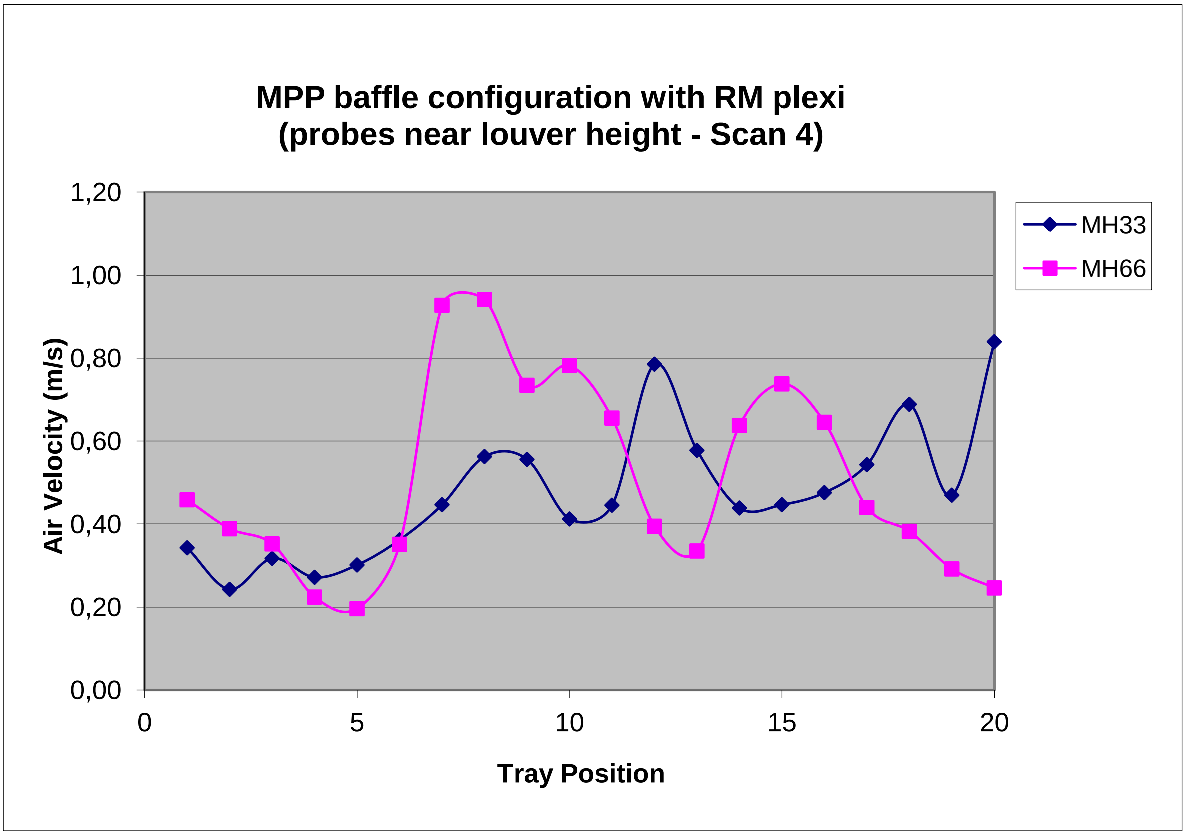


Fig 2.1

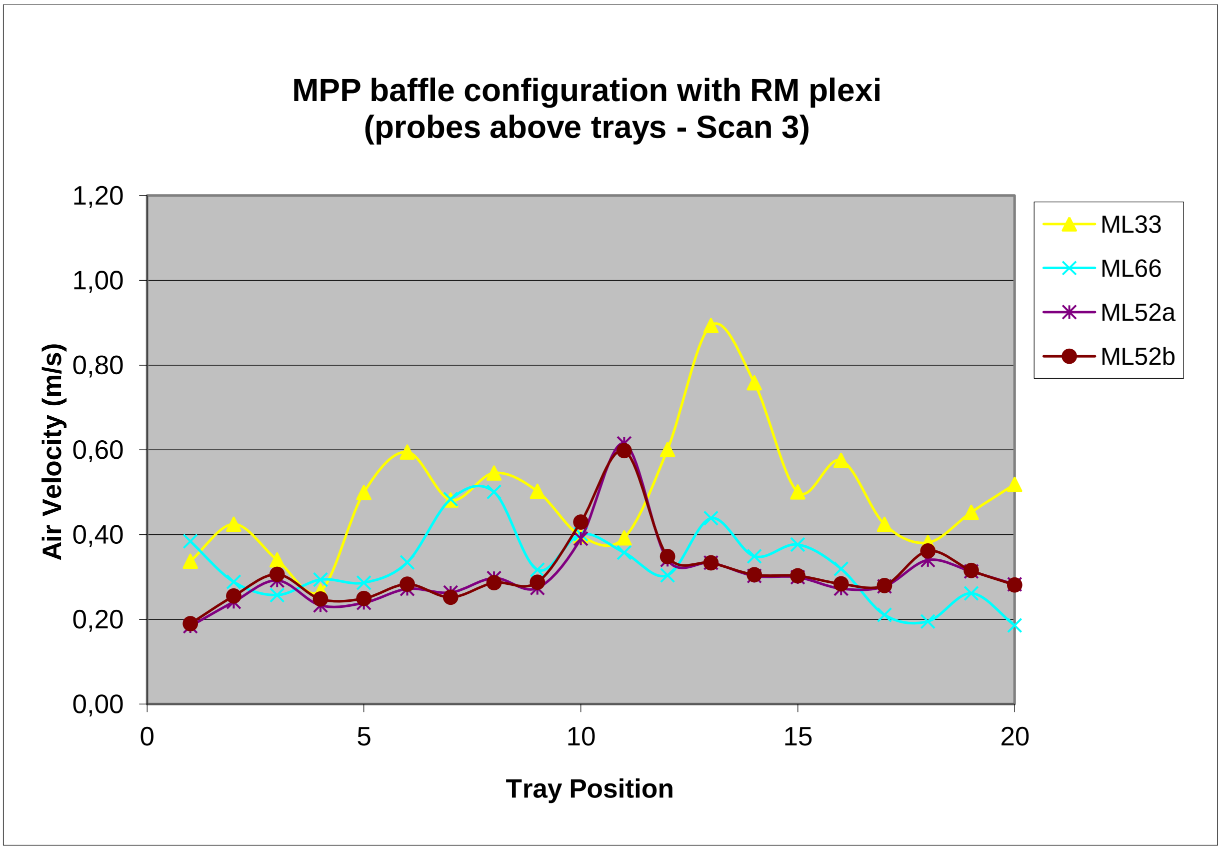


Fig 2.2

2.2- TEST USING PLASTIC SHEETS:

The test was performed using the nominal MPP disposition of the plastic sheets. The MPP plastic sheets disposition covers almost completely the supposed free space that is necessary between the trays. Using this plastic disposition, the air is forced to both ends of the HPC1.

Results: To have a better vision of the air distribution the graph is divide in two, high configuration of probes (Fig 2.3), and low configuration of probes (Fig 2.4).

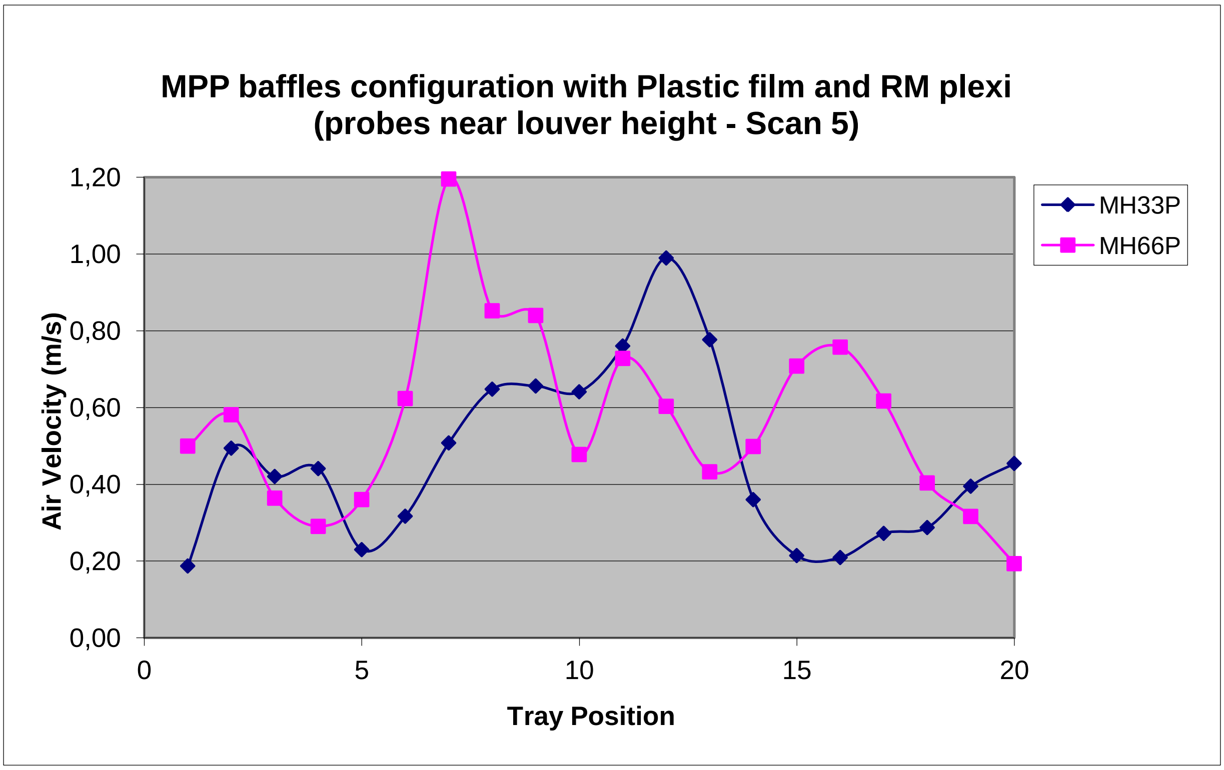

MPP baffles configuration with Plastic film and RM plexi
(probes near louver height - Scan 5)
Air Velocity (m/s)
Tray Position
MH33P
MH66P
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0
5
10
15
20

Fig 2.3.

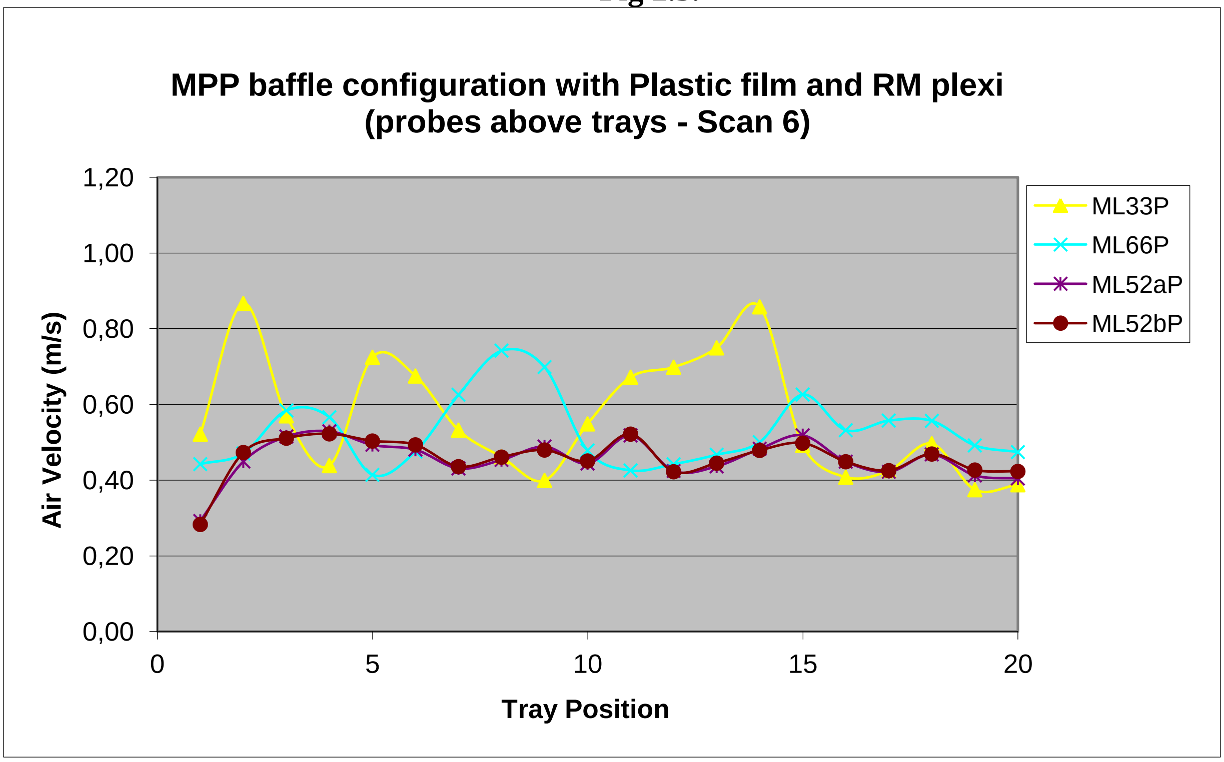

MPP baffle configuration with Plastic film and RM plexi
(probes above trays - Scan 6)
Air Velocity (m/s)
Tray Position
ML33P
ML66P
ML52aP
ML52bP
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0
5
10
15
20

Fig 2.4.

2.3.- CONCLUSIONS:

The plastic disposition directly affects the distribution of air flow inside HPC1 ; comparing the results it is very obvious that the free space between the trays it is necessary to have a suction flow between every tray junction, if these spaces are blocked by the plastic sheet, the dynamics of air flow inside the chamber changes completely, and the air flow average increases very much. The air flow at the low level of the plants increases to almost double using the plastic sheet covering the free space.

3.- *VELOCITY MAPPING TO VERIFY LOUVERS CONFIGURATION*

In order to verify the impact of the different louver configurations into the air distribution, MPP decided to perform some tests to compare the results. The baffle configuration selected for the test was the original one provide by Angstrom , and the test was performed without plastic sheets on the trays. This test was performed using the same probes disposition and the same Accu-track system used in the previous tests.

3.1.- TEST USING ORIGINAL ANGSTROM LOUVERS CONFIGURATION:

The test was done mounting the original white louvers supplied by Angstrom Engineering trying to reproduce the same configuration that arrived to MPP.
Results: To have a better vision of the air distribution, the graph is divided in two, high configuration of probes (Fig 3.1), and low configuration of probes (Fig 3.2).

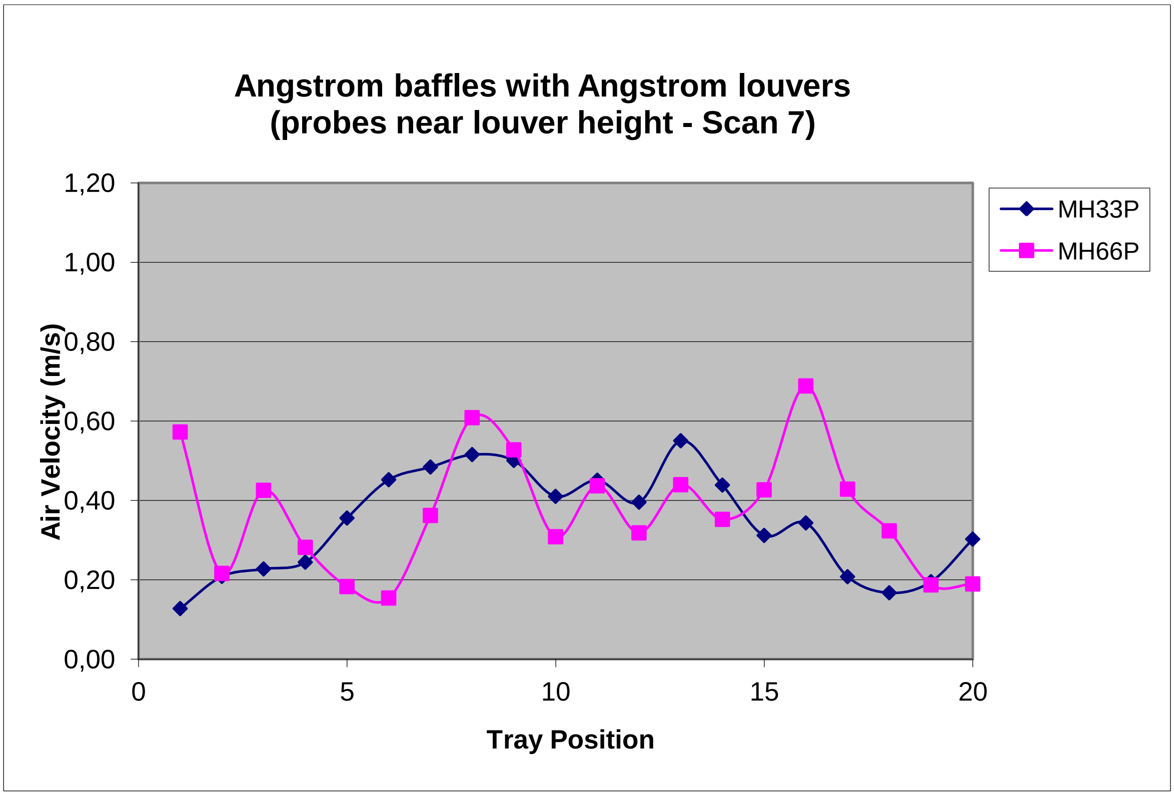


Fig 3.1

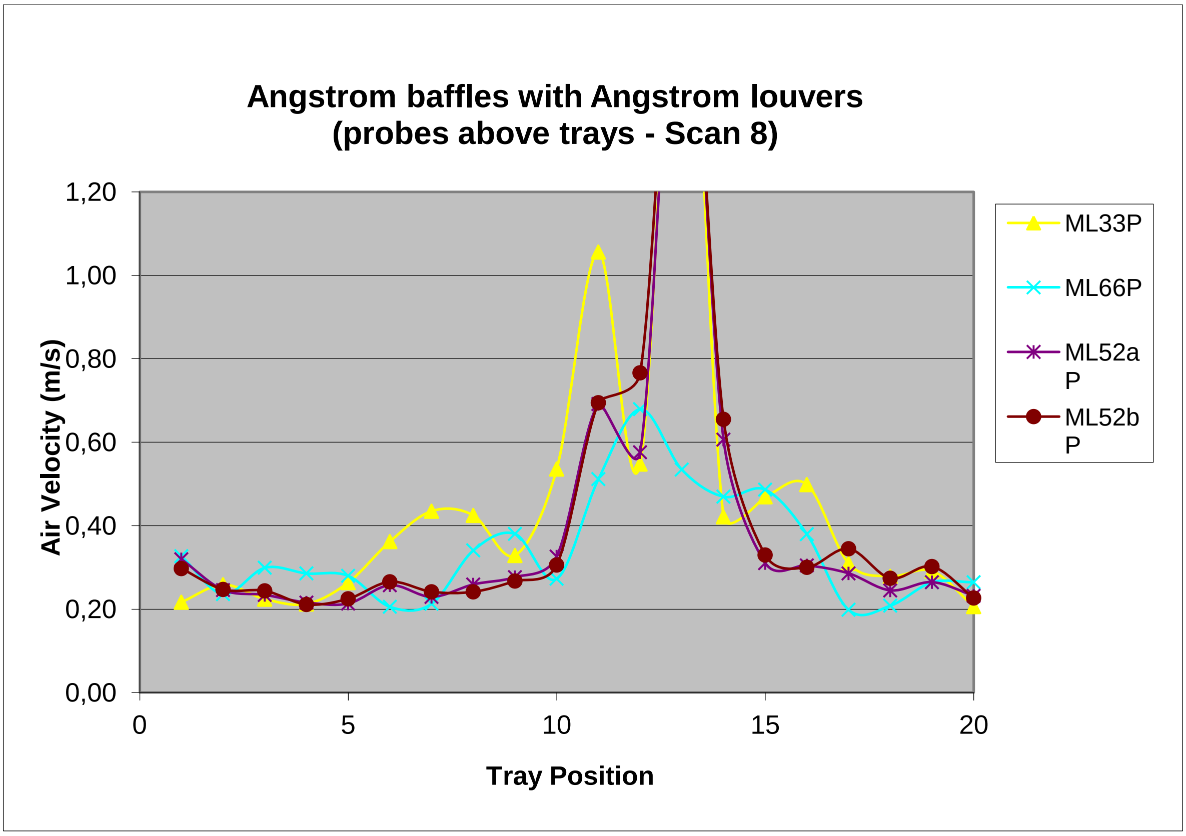


Fig 3.2

3.2.- TEST USING PLASTIC SHEETS WITH HOLES SIMULATING THE PLEXI-GLASS LOUVERS CONFIGURATION INTO THE GRIDS 5 AND 6:

To solve momentarily the big flow into the grids 5 and 6, MPP manufactured Plexi-glass perforated louvers to reduce the flow. This provisional louvers were not used in this test, but in order to verify the efficiency of the change, analogue plastic sheet louvers like the Plexi-glass louvers were manufactured for the test, and mounted in the back of the original grid, inside the plenum.

Results: To have a better vision of the air distribution the graph is divide in two, high probes configuration **(Fig 3.3)**, and low probes configuration (F**ig 3.4).**

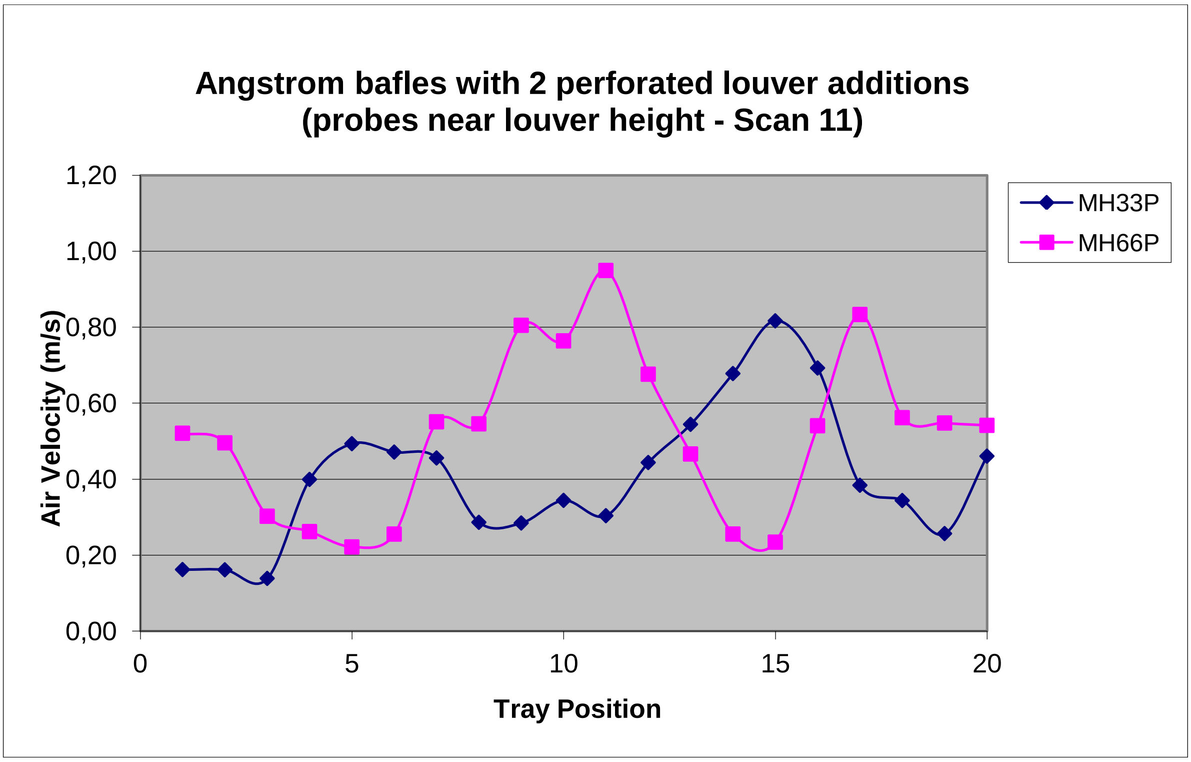

Angstrom bafles with 2 perforated louver additions
(probes near louver height - Scan 11)
1,20
1,00
0,80
0,60
0,40
0,20
0,00
Air Velocity (m/s)
0
5
10
15
20
Tray Position
MH33P
MH66P

Fig 3.3

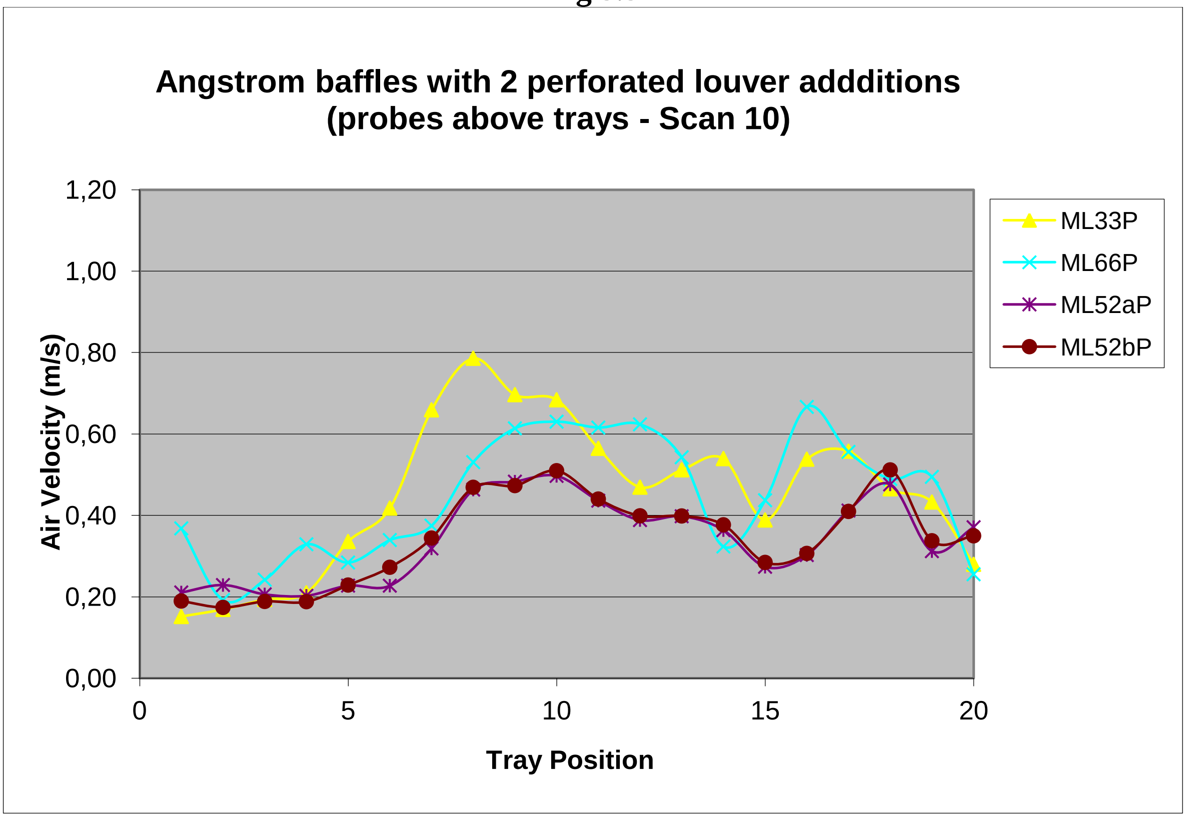

Angstrom baffles with 2 perforated louver adddititions
(probes above trays - Scan 10)
1,20
1,00
0,80
0,60
0,40
0,20
0,00
Air Velocity (m/s)
0
5
10
15
20
Tray Position
ML33P
ML66P
ML52aP
ML52bP

Fig 3.4

3.3.- TEST USING THE NEW METAL LOUVERS MOUNTED INTO THE ORIGINAL GRID CONFIGURATION INTO THE GRIDS 5 AND 6:

After the verification of efficiency of the provisional plastic perforate louvers, MPP decided to make a rigid metal perforated louver to be installed in the back of the original Angstrom grids.

Results: To have a better vision of the air distribution the graph is divide in two, high probes results **fig 3.5**, and low probes results **fig 3.6.**

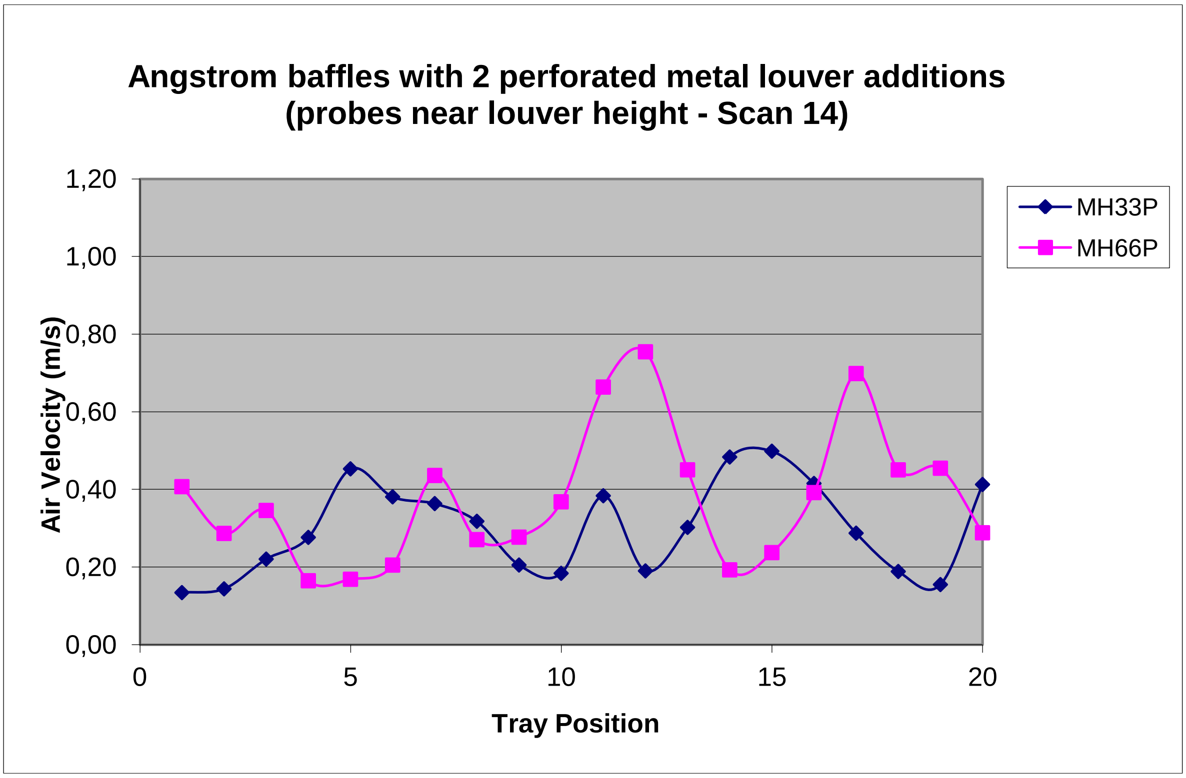


Fig 3.5

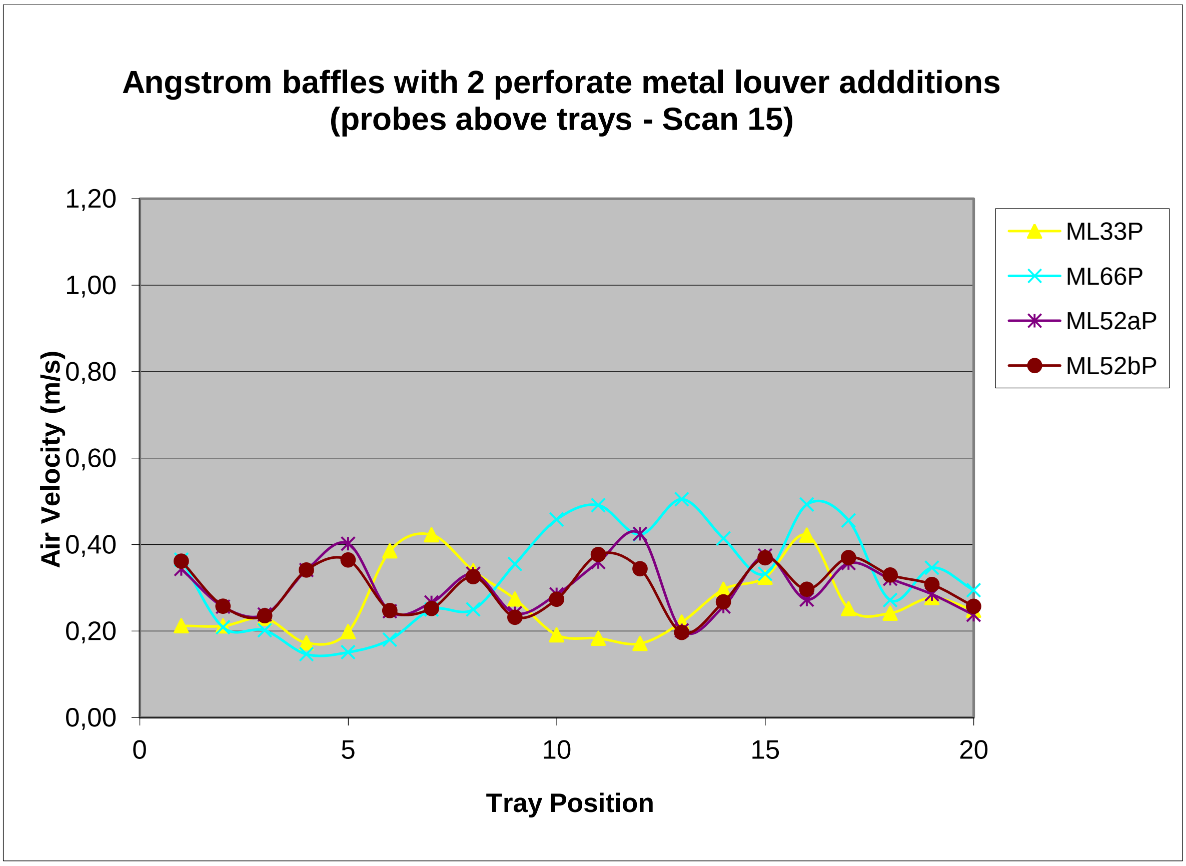


Fig 3.6

3.4.- CONCLUSIONS:

The original Angstrom configuration using only the white grid,demonstrated a very high laminar air flow between trays 10 and 15 that could have contributed to the yellow colour of the plants in these trays, that appeared in the previous grow test. The new louvers, plastic and metal, produced the effect inside the plenum of providing a better distribution of the air in all the grids, also in the plenum. This better distribution of the air flow through the grids had a very good impact on the dynamics of air flow movement inside the HPC1 growing area.

Appendix 6: *Sherpa Engineering report on maintenance interventions in the MPP*

MELiSSA Pilot Plant

Universitat Autònoma de Barcelona

Document Identification :	Type - Number	Issue
Report on Maintenance Interventions in the MPP	**MPP-REP-11-0002**	0

MPP-REP-11-0002(0)_Report on Maintenance Interventions in the MPP

Company name : SHERPA

Period considered : 1/10/2010 - 30/9/2011

Items on which maintenance was performed : control software (SHERPA), control hardware and HMI softare (NTE-SENER), process equipment (CIFA)

#	Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
27	2010-10-22	HPC1	C	New tuning parameters of the CO2 controller JUSTIFICATION: New position of the CO2 analyzer input.	closed
28	2010-10-22	HPC1	C	Stop the CO2 injection in case of air lock opening JUSTIFICATION: safety for CO2 injection (in automatic mode)	closed
29	2011-01-24	HPC1	C	CO2: add another variable (OPC recording) which calculates the total volume injected (integrator block) with the mass flow meter reading value. The goal is to monitor the gap between both variables, then to choose the definitive one. - Add a variable for the calculation in "mol". JUSTIFICATION: implementation of the added hardware (metering pump for nutrient solution control and optimization of the injection calculation (pH/EC/CO2)	closed
30	2011-01-24	HPC1	C	CO2: Add a variable for the calculation in "mol". JUSTIFICATION: Idem than above	closed
31	2011-01-24	HPC1	C	NUTRIENT: Two Metring pumps are added (ON/OFF signal). JUSTIFICATION: Idem than above	closed
32	2011-01-24	HPC1	C	NUTRIENT: As the pumps will not have exactly the same injection, Sherpa needs to add a separated tag for the calculation of the injected volume. This calculation will be done in automatic and manual mode. In manual mode, we keep the opening injection time. JUSTIFICATION: Idem than above	closed
33	2011-01-24	HPC1	C	pH: Add a conversion from opening time to ml. UAB has to send the conversion law to Sherpa. The Conversion variable needs to be configurable and recorded by the HMI. The calculation will be done in automatic and manual mode. In manual mode, we keep the opening injection time. JUSTIFICATION: Idem than above	closed

List of keywords for each field

Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
	C1	C		closed
	C2	P		open
	C3			
	C4a			
	HPC1			
	C5			
	MPP facilities			
	MPP utilities			
	MPP shared equipment			

MELiSSA Pilot Plant
Universitat Autònoma de Barcelona

Document Identification :	Type - Number	Issue
Report on Maintenance Interventions in the MPP	MPP-REP-11-0002	0

MPP-REP-11-0002(0)_Report on Maintenance Interventions in the MPP

Company name : SHERPA

Period considered : 1/10/2010 - 30/9/2011

Items on which maintenance was performed : control software (SHERPA), control hardware and HMI softare (NTE-SENER), process equipment (CIFA)

#	Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
34	2011-03-09	HPC1	C	When the condensate pump is running a timer starts. If the LSL_4010_01 is not set after 6min 05s a pulse is send to reset the pump GP_4010_01 JUSTIFICATION: As the LSL_4010_02 is not working well, a safety is implemented to stop the pump after 6 minutes and 5 seconds	closed
35	2011-06-20	HPC1	C	The valve is locked if LSL signal is triggered. The calculation of the injected solution doesn't increased. JUSTIFICATION: It was decided previously not to stop the pH injection (ACID and BASE) in case of LSL signal. This decision was taken due to the position of the LSL (middle of the vessel). The problem is: the controller continues to open the valve thus the calculation of the solution injected continues to increase.	closed
36	2011-06-20	HPC1	C	Solution A and B can only be injected together. It means that the EC injection is stop if one of the LSL signal is triggered. JUSTIFICATION: The injection of solution A was not stopped when LSL of solution B was empty and vice versa.	closed
37	2011-07-25	HPC1	C	The integrator block is reset when the value reaches 1000000, then the calculated value is added to the total value. At the same time (same PLC cycle) the Integrator block is reset. It prevents to reach very high number at the integrator block output. JUSTIFICATION: The calculation of the CO2 injection stops when the calculated value reaches a too high number. For information, this block calculates the volume injected in ml/min then the value is converted in Litre. That why the output value of the integrator block could increase a lot.	closed
38	2011-07-29	HPC1	C	Re-create the old tags named : CL4107_Base_Opening_Time (PLC @:400186) CL4107_Acid_Opening_Time (PLC @:40018_) JUSTIFICATION: UAB (Richard Cote) wants to have the value which permits to calculate the injection in ml of the acid and base solution.	closed
39	2011-08-02	HPC1	C	Safety for Door C open reconnected (ZZ_4101_01). If open, it prevents to inject CO2 Thresholds changed FT_4106_01_LIM_LL 3 L/mn (previously 6) FT_4106_01_LIM_L 8 L/mn (No change) FT_4106_01_LIM_H 20 L/mn (previously 15) FT_4106_01_LIM_HH 25 L/mn (previously 17) Offsets adjustment pH offset changed from 0.8 to 0.92 EC offset changed from 0.26 to 0.30 JUSTIFICATION: Door safety sensor is repaired , threshold changes (ask by RC) and offset reconsideration after new calibration test.	closed

List of keywords for each field

Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
	C1	C		closed
	C2	P		open
	C3			
	C4a			
	HPC1			
	C5			
	MPP facilities			
	MPP utilities			
	MPP shared equipment			

Appendix 7: *NTE's report on maintenance interventions in the MPP*

MELiSSA Pilot Plant
Universitat Autònoma de Barcelona

Document Identification :	Type - Number	Issue	
Report on Maintenance Interventions in the MPP	**MPP-REP-11-0002**	0	

MPP-REP-11-0002(0)_Report on Maintenance Interventions in the MPP

Company name : NTE-SENER

Period considered : 1/10/2010 - 30/9/2011

Items on which maintenance was performed : control software (SHERPA), control hardware and HMI softare (NTE-SENER), process equipment (CIFA)

#	Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
3	05-01-11	HPC1	C	Chamber optimization and added tags. The loops involved in the modifications were the injection of CO2, the nutrients addition and the acid/base addition. The CO2 injection control PID was modified by sherpa to optimize the injecion volume and the response time. The nutrients addition and the acid/base addition had new Opening time variables (CL4108_SOLA_OP_time, CL4108_SOLB_OP_time,CL4107_ACID_OP_time,CL4107_BASE_OP_time), these variables are used to quantified the add volumne. The acid/base addition have new variables to fill the flow factor necessary to the internal PLC volume calculations.	closed
5	21-01-11	HPC1	C	inversion between the base and the acid flow factor. The old version had a mistake and the acid/base flow factors were in inversed positions.	closed
6	24-01-11	HPC1	C	calibration factor of the Nutrient solution & problem concerning the variable "CL4108_SolB_OP_Time". The nutrient solution A/B addition have a new variables to fill the flow factor necessary to the internal PLC volume calculations. The variable CL4108_SolB_OP_time had a adress problem, now the adress is correct.	closed
7	26-01-11	HPC1	C	problem on the time defined by the operator (CL4108_SolB_OP_Time), the variable was impossible to verify by the HMI. NTE included the variable in the comunication data base to allow the verification of the values in the HMI.	closed
15	28-07-11	HPC1		another intervention was executed in CIVb-HPC1 compartment on 27-28/07/2011. The following tags were added to the HPC1 Group of the Historical Assign: - CL4107_Base_Injection - CL4107_Acid_Injection - CL4107_Base_Calibration - CL4107_Acid_Calibration - CL4108_SolA_Injection - CL4108_SolB_Injection - CL4108_SolA_calibration - CL4108_SolB_calibration - CL4113_CO2_injected_in_mol -CL4110_Condensate_TotalVolume (400250) -CL4108_SOLA_OP_TIME (400231) -CL4108_SOLB_OP_TIME (400390)	closed

MELiSSA Pilot Plant

Universitat Autònoma de Barcelona

Document Identification :	Type - Number	Issue
Report on Maintenance Interventions in the MPP	**MPP-REP-11-0002**	0

MPP-REP-11-0002(0)_Report on Maintenance Interventions in the MPP

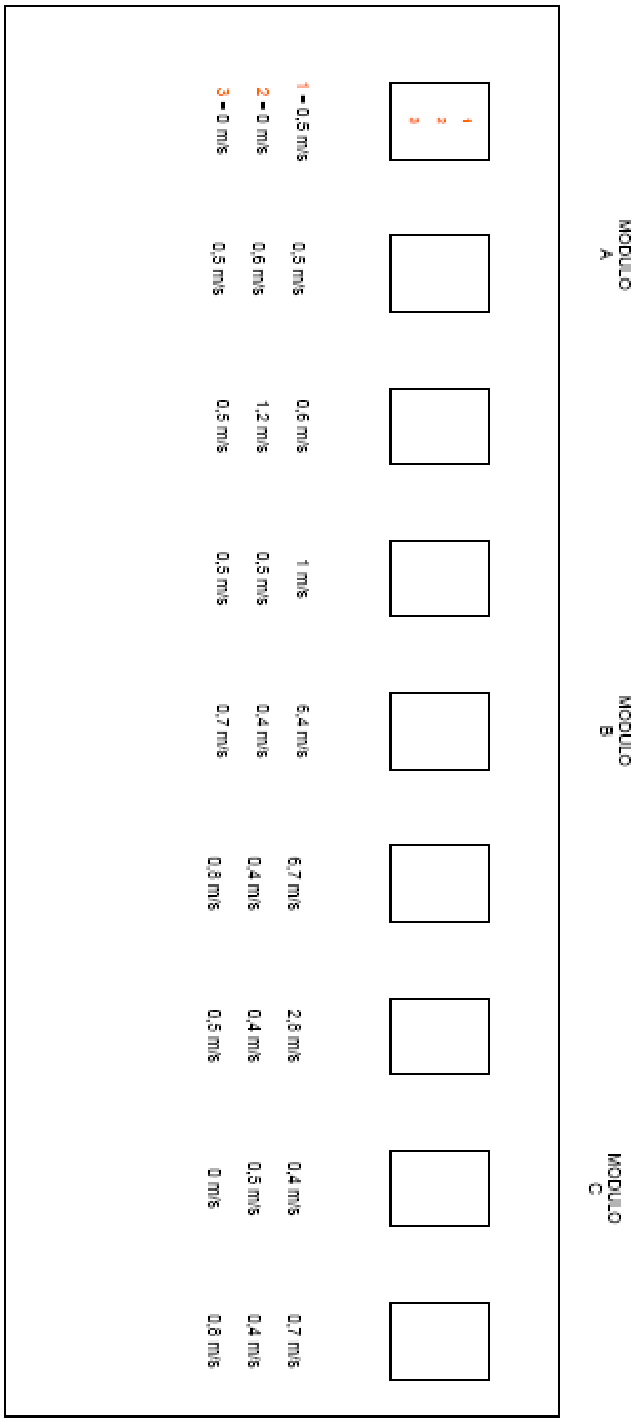
Company name : NTE-SENER

Period considered : 1/10/2010 - 30/9/2011

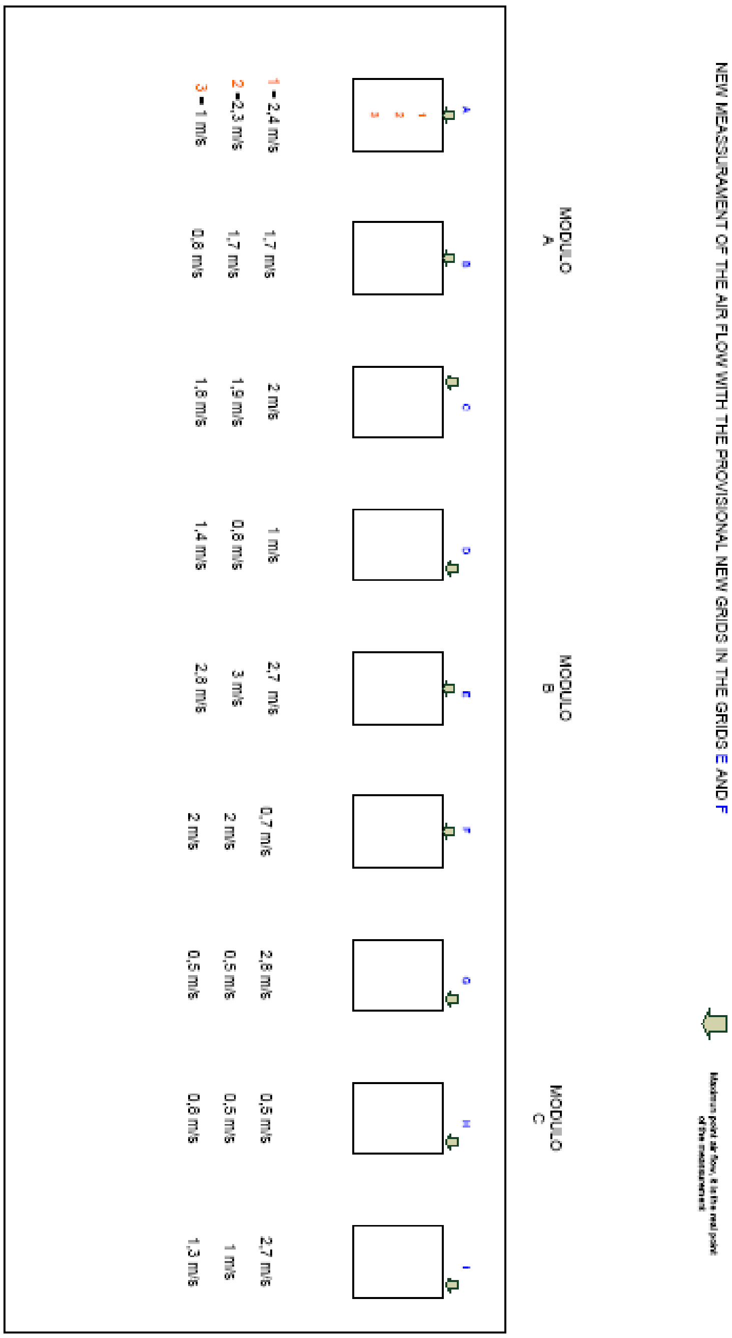
Items on which maintenance was performed : control software (SHERPA), control hardware and HMI softare (NTE-SENER), process equipment (CIFA)

#	Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
1	**11-10-10**	**C1**	**C**	**Bioreactor pressure threshold changes**	**closed**
3	05-01-11	HPC1	C	Chamber optimization and added tags. The loops involved in the modifications were the injection of CO2, the nutrients addition and the acid/base addition. The CO2 injection control PID was modified by sherpa to optimize the injecion volume and the response time. The nutrients addition and the acid/base addition had new Opening time variables (CL4108_SOLA_OP_time, CL4108_SOLB_OP_time,CL4107_ACID_OP_time,CL4107_BASE_OP_time), these variables are used to quantified the add volumne. The acid/base addition have new variables to fill the flow factor necessary to the internal PLC volume calculations.	closed
5	21-01-11	HPC1	C	inversion between the base and the acid flow factor. The old version had a mistake and the acid/base flow factors were in inversed positions.	closed
6	24-01-11	HPC1	C	calibration factor of the Nutrient solution & problem concerning the variable "CL4108_SolB_OP_Time". The nutrient solution A/B addition have a new variables to fill the flow factor necessary to the internal PLC volume calculations. The variable CL4108_SolB_OP_time had a adress problem, now the adress is correct.	closed
7	26-01-11	HPC1	C	problem on the time defined by the operator (CL4108_SolB_OP_Time), the variable was impossible to verify by the HMI. NTE included the variable in the comunication data base to allow the verification of the values in the HMI.	closed
15	28-07-11	HPC1		another intervention was executed in CIVb-HPC1 compartment on 27-28/07/2011. The following tags were added to the HPC1 Group of the Historical Assign: - CL4107_Base_Injection - CL4107_Acid_Injection - CL4107_Base_Calibration - CL4107_Acid_Calibration - CL4108_SolA_Injection - CL4108_SolB_Injection - CL4108_SolA_calibration - CL4108_SolB_calibration - CL4113_CO2_injected_in_mol -CL4110_Condensate_TotalVolume (400250) -CL4108_SOLA_OP_TIME (400231) -CL4108_SOLB_OP_TIME (400390)	closed

Appendix 8: *Velocity measurement on MAY 2010 Angstrom original grids*



Appendix 9: *Velocity measurement on JUN 2010 new provisional grids in the E and F position*



Appendix 10: *CIFA's report on maintenance interventions in the MPP*

MELiSSA Pilot Plant

Universitat Autònoma de Barcelona

Document Identification :	Type - Number	Issue
Report on Maintenance Interventions in the MPP	**MPP-REP-11-0002**	0

MPP-REP-11-0002(0)_Report on Maintenance Interventions in the MPP

Company name : CIFA

Period considered : 1/10/2010 - 30/9/2011

Items on which maintenance was performed : control software (SHERPA), control hardware and HMI softare (NTE-SENER), process equipment (CIFA)

#	Date	Compartment	Type of maintenance	Description of the maintenance intervention and comments	Status
8	20-07-10	HPC1	C	Modificatins air conduction	closed
9	25-11-10	HPC1	C	Install solenoid valves for acid and base	closed
10	13-12-10	HPC1	C	Supports pumps	closed
12	02-02-11	HPC1	C	Door fittings	closed
14	03-03-11	HPC1	P	Solenoid valves for stock	closed
15	23-03-11	HPC1	C	Reparir pump	closed
19	25-03-11	HPC1	P	Install emergeny stop	closed
20	14-04-11	HPC1	P	Supports	closed
21	14-04-11	HPC1	P	Install gas collector	closed
34	08-09-11	HPC1	P	Identifiers for trays	closed
36	30-09-11	HPC1	C	EPDM connections caps	closed

Appendix 11: *Global summary of maintenance interventions in the HPC1*

MELiSSA Pilot Plant

Universitat Autònoma de Barcelona

Document Identification :	Type - Number	Issue
Report on Maintenance Interventions in the MPP	**MPP-REP-11-0002**	0

Report on Maintenance Interventions in the MPP for HPC1 (2010-2011)

Company name : SHERPA, NTE and CIFA

Period considered : 1/10/2010 - 30/9/2011

Items on which maintenance was performed : control software (SHERPA), control hardware and HMI softare (NTE-SENER), process equipment (CIFA)

#	Date	Compartment	Subcontractor	Type of maintenance (1)	Description of the maintenance intervention and comments	Status
1	20-07-10	HPC1	CIFA	C	Modificatins air conduction	closed
2	22/10/2010	HPC1	SHERPA	C	New tuning parameters of the CO2 controller JUSTIFICATION: New position of the CO2 analyzer input.	closed
3	22/10/2010	HPC1	SHERPA	C	Stop the CO2 injection in case of air lock opening JUSTIFICATION: safety for CO2 injection (in automatic mode)	closed
4	25-11-10	HPC1	CIFA	C	Install solenoid valves for acid and bases	closed
5	13-12-10	HPC1	CIFA	C	Supports pumps	closed
6	05-01-11	HPC1	NTE	C	Chamber optimization and added tags. The loops involved in the modifications were the injection of CO2, the nutrients addition and the acid/base addition. The CO2 injection control PID was modified by sherpa to optimize the injecion volume and the response time. The nutrients addition and the acid/base addition had new Opening time variables (CL4108_SOLA_OP_time, CL4108_SOLB_OP_time,CL4107_ACID_OP_time,CL4107_BASE_OP_time), these variables are used to quantified the add volumne. The acid/base addition have new variables to fill the flow factor necessary to the internal PLC volume calculations.	closed
7	21-01-11	HPC1	NTE	C	inversion between the base and the acid flow factor. The old version had a mistake and the acid/base flow factors were in inversed positions.	closed
8	24/01/2011	HPC1	SHERPA	C	CO2: add another variable (OPC recording) which calculates the total volume injected (integrator block) with the mass flow meter reading value. The goal is to monitor the gap between both variables, then to choose the definitive one. - Add a variable for the calculation in "mol". JUSTIFICATION: implementation of the added hardware (metering pump for nutrient solution control and optimization of the injection calculation (pH/EC/CO2)	closed
9	24/01/2011	HPC1	SHERPA	C	CO2: Add a variable for the calculation in "mol". JUSTIFICATION: Idem than above	closed
10	24/01/2011	HPC1	SHERPA	C	NUTRIENT: Two Metring pumps are added (ON/OFF signal). JUSTIFICATION: Idem than above	closed
11	24/01/2011	HPC1	SHERPA	C	NUTRIENT: As the pumps will not have exactly the same injection, Sherpa needs to add a separated tag for the calculation of the injected volume. This calculation will be done in automatic and manual mode. In manual mode, we keep the opening injection time. JUSTIFICATION: Idem than above	closed
12	24/01/2011	HPC1	SHERPA	C	pH: Add a conversion from opening time to ml. UAB has to send the conversion law to Sherpa. The Conversion variable needs to be configurable and recorded by the HMI. The calculation will be done in automatic and manual mode. In manual mode, we keep the opening injection time. JUSTIFICATION: Idem than above	closed

13	24-01-11	HPC1	NTE	C	calibration factor of the Nutrient solution & problem concerning the variable "CL4108_SolB_OP_Time". The nutrient solution A/B addition have a new variables to fill the flow factor necessary to the internal PLC volume calculations. The variable CL4108_SolB_OP_time had a adress problem, now the adress is correct.	closed
14	26-01-11	HPC1	NTE	C	problem on the time defined by the operator (CL4108_SolB_OP_Time), the variable was impossible to verify by the HMI. NTE included the variable in the comunication data base to allow the verification of the values in the HMI.	closed
15	02-02-11	HPC1	CIFA	C	Door fittings	closed
16	03-03-11	HPC1	CIFA	P	Solenoid valves for stock	closed
17	09/03/2011	HPC1	SHERPA	C	When the condensate pump is running a timer starts. If the LSL_4010_01 is not set after 6min 05s a pulse is send to reset the pump GP_4010_01 JUSTIFICATION: As the LSL_4010_02 is not working well, a safety is implemented to stop the pump after 6 minutes and 5 seconds	closed
18	23-03-11	HPC1	CIFA	C	Reparir pump	closed
19	25-03-11	HPC1	CIFA	P	Install emergeny stop	closed
20	14-04-11	HPC1	CIFA	P	Supports	closed
21	14-04-11	HPC1	CIFA	P	Install gas collector	closed
22	20/06/2011	HPC1	SHERPA	C	The valve is locked if LSL signal is triggered. The calculation of the injected solution doesn't increased. JUSTIFICATION: It was decided previously not to stop the pH injection (ACID and BASE) in case of LSL signal. This decision was taken due to the position of the LSL (middle of the vessel). The problem is: the controller continues to open the valve thus the calculation of the solution injected continues to increase.	closed
23	20/06/2011	HPC1	SHERPA	C	Solution A and B can only be injected together. It means that the EC injection is stop if one of the LSL signal is triggered. JUSTIFICATION: The injection of solution A was not stopped when LSL of solution B was empty and vice versa.	closed
24	25/07/2011	HPC1	SHERPA	C	The integrator block is reset when the value reaches 1000000, then the calculated value is added to the total value. At the same time (same PLC cycle) the Integrator block is reset. It prevents to reach very high number at the integrator block output. JUSTIFICATION: The calculation of the CO2 injection stops when the calculated value reaches a too high number. For information, this block calculates the volume injected in ml/min then the value is converted in Litre. That why the output value of the integrator block could increase a lot.	closed
25	28-07-11	HPC1	NTE		another intervention was executed in CIVb-HPC1 compartment on 27-28/07/2011. The following tags were added to the HPC1 Group of the Historical Assign: - CL4107_Base_Injection - CL4107_Acid_Injection - CL4107_Base_Calibration - CL4107_Acid_Calibration - CL4108_SolA_Injection - CL4108_SolB_Injection - CL4108_SolA_calibration - CL4108_SolB_calibration - CL4113_CO2_injected_in_mol -CL4110_Condensate_TotalVolume (400250) -CL4108_SOLA_OP_TIME (400231) -CL4108_SOLB_OP_TIME (400390)	closed
26	29/07/2011	HPC1		C	Re-create the old tags named : CL4107_Base_Opening_Time (PLC @:400186) CL4107_Acid_Opening_Time (PLC @:40018_) JUSTIFICATION: UAB (Richard Cote) wants to have the value which permits to calculate the injection in ml of the acid and base solution.	closed

27	02/08/2011	HPC1	SHERPA	C	Safety for Door C open reconnected (ZZ_4101_01). If open, it prevents to inject CO2 Thresholds changed FT_4106_01_LIM_LL 3 L/mn (previously 6) FT_4106_01_LIM_L 8 L/mn (No change) FT_4106_01_LIM_H 20 L/mn (previously 15) FT_4106_01_LIM_HH 25 L/mn (previously 17) Offsets adjustment pH offset changed from 0.8 to 0.92 EC offset changed from 0.26 to 0.30 JUSTIFICATION: Door safety sensor is repaired , threshold changes (ask by RC) and offset reconsideration after new calibration test.	closed
28	08-09-11	HPC1	CIFA	P	Identifiers for trays	closed
29	30-09-11	HPC1	CIFA	C	EPDM connections caps	closed

(1) corrective : C - in case of repair/modification after a reported incidence or non conformance ; preventive : P - in case of anticipation of some tasks as per the maintenance plan or as per requested by MPP