User Manual

HS40 Series II

KISTERS
Empowering decisions of tomorrow

Table of Contents

I Disclaimer

The information provided in this manual was deemed accurate as of the publication date. However, updates to this information may have occurred.

This manual does not include all of the details of design, production, or variation of the equipment nor does it cover every possible situation which may arise during installation, operation or maintenance. KISTERS shall not be liable for any incidental, indirect, special or consequential damages whatsoever arising out of or related to this documentation and the information contained in it, even if KISTERS has been advised of the possibility of such damages.

Any errors found in any KISTERS product should be reported to KISTERS where every effort will be made to quickly resolve the problem.

This document is public.

II Safety Instructions

- Read the user manual including all operating instructions prior to installing, connecting and powering up the KISTERS HS40S2. The manual provides information on how to operate the product. The manual is intended to be used by qualified personnel, i.e. personnel that have been adequately trained, are sufficiently familiar with installation, mounting, wiring, powering up and operation of the product.
- Keep the user manual on hand for later reference!
- If you encounter problems understanding the information in the manual (or part thereof), please consult the manufacturer or its appointed reseller for further support.
- KISTERS HS40S2 is intended to be used in hydrometeorological or environmental monitoring applications.
- Before starting to work, you have to check the functioning and integrity of the system.
    - Check for visible defects on the HS40S2, this may or may not include any or all of the following: mounting facilities, connectors and connections, mechanical parts, internal or external communication devices, power supplies or power supply lines, etc.
    - If defects are identified that could compromise operational safety, work must be stopped immediately. This applies to defects detected both before work begins and during operation.
- Do not use the KISTERS HS40S2 in areas where there is a danger of explosion.
- The present user manual specifies environmental/climatic operating conditions as well as mechanical and electrical conditions. Installation, wiring, powering up and operating the KISTERS HS40S2 must strictly comply with these specifications.
- Perform maintenance only when tools or machinery are not in operation.
- If guards are removed to perform maintenance, replace them immediately after servicing.
- Never make any electrical or mechanical diagnostics, inspections or repairs under any circumstances. Return the product to the manufacturer's named repair centre. You can find information on how to return items for repair in the relevant section of the KISTERS website.

Disposal instructions: After taking the KISTERS HS40S2 out of service, it must be disposed of in compliance with local waste and environmental regulations. The KISTERS HS40S2 is never to be disposed of in household waste!

Inputs and outputs of the device are protected against electric discharges and surges (so-called ESD). Do not touch any part of the electronic components! If you need to touch any part, please discharge yourself, i.e. by touching grounded metal parts.

1 Introduction

Thank you for choosing our product. We hope you will enjoy using the device.

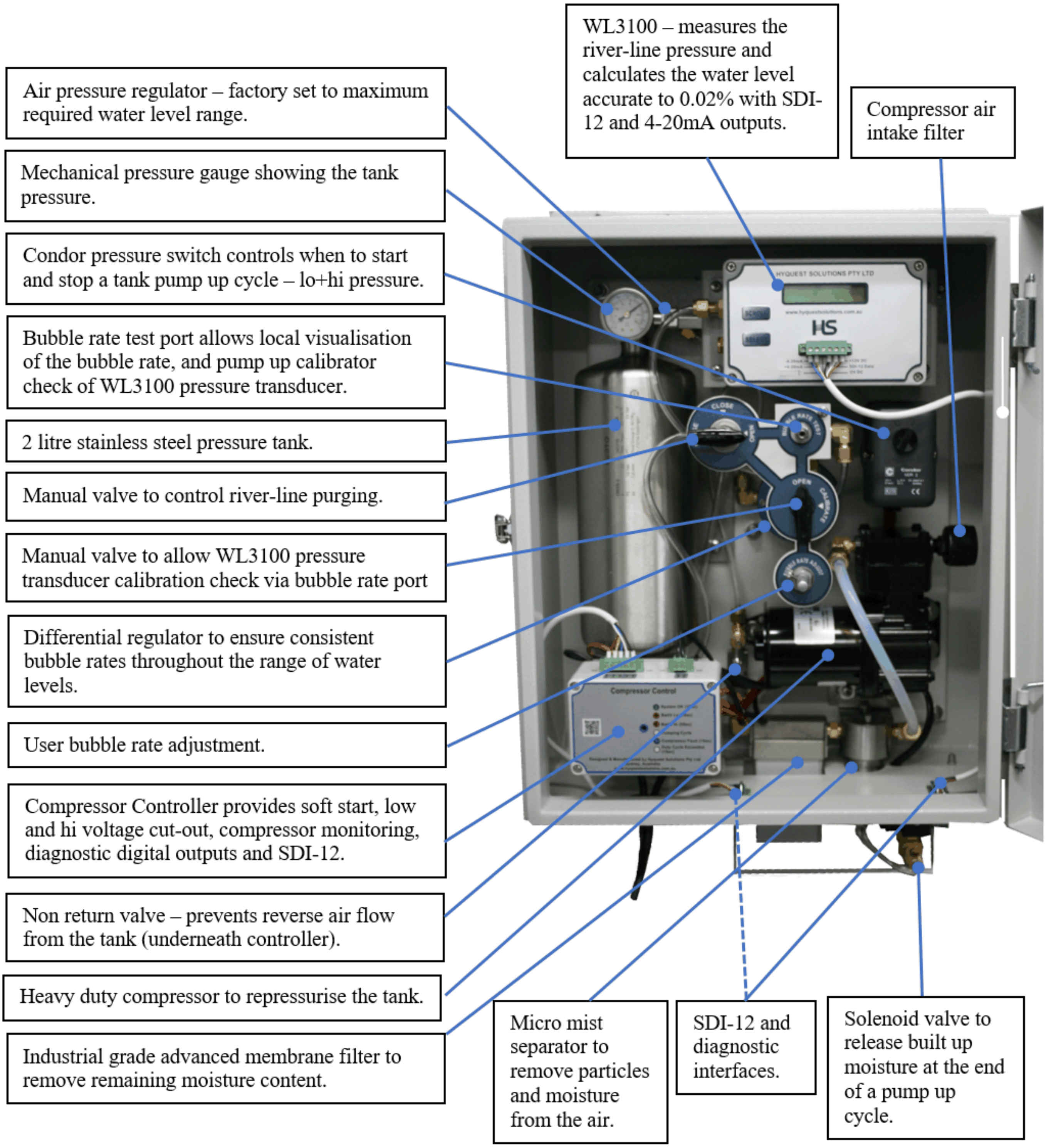
KISTERS manufactures, sells, installs and operates quality instrumentation, data loggers and communication technology. Products are designed with passion for environmental monitoring and with a deep understanding of the quality, accuracy and robustness needed to fulfil the requirements of measurement practitioners in the field.

The present User Manual will help you understand, install and deploy the device. If, however, you feel that a particular information is missing, incomplete or confusing, please do not hesitate to contact us for further support!

The HS40 Series II Gas Purge Compressor and Bubbler System has been designed to replace conventional nitrogen gas bottle supply to bubble units or gas purge systems. The HS40 is used for measuring water level in dams, rivers, canals and tanks with up to 40 mH2O (130 ft) head.

1.1 Product Overview

The HS40 Series II is designed to replace conventional Dry Nitrogen bubbler systems for water level measurement. It can operate with up to 40 m (130 ft) head of water. The system is low maintenance and has a low average power consumption.



2 Installation

The HS40 Series II MUST be mounted in a vertical position (not laying flat as shown). The micro mist separator and auto purge moisture feature will not function properly if the unit is in a horizontal position.

Before connecting 12 V power to the HS40 Series II, fit the 3/8 inch river-line where shown (optional ¼ inch fitting).

Connect the 12 V DC battery directly to the power cable shown, and add a mains or solar charger as required.

The status LED, on the compressor controller, will cycle through its initial sequence, and then if the tank pressure is less than 400 kPa (58 psi) [±20%], the compressor will start and pump the tank pressure up to 750 kPa (110 psi) [±20%].

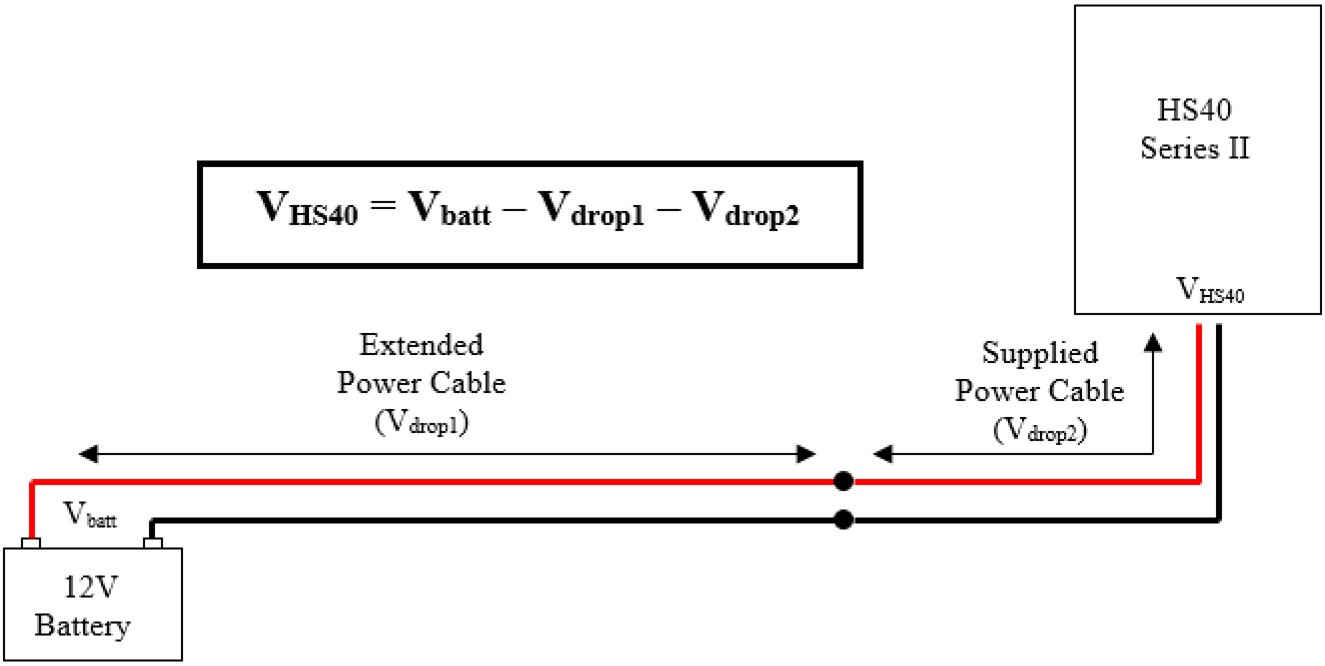
This chapter contains the following subsections:

2.1 Extending the Battery Cables

The HS40 Series II is supplied with a 2 m power cable, with each core being 6 mm^2. If the user needs to extend this cable, extreme caution should be exercised, because whenever high currents are drawn through cables, there will be voltage drops!

With the supplied cable (2 m of 6 mm^2) there is a 0.18 V drop on each conductor when the compressor draws 30 A. Since there is a positive and negative wire, the voltage seen by the HS40 Series II is 2 x 0.18 V = 0.36 V less than the voltage seen at the battery terminals – and at 30 A the battery voltage will also droop.

(This is before the cables are extended.)



Use the following table to get an idea of the total cable voltage drop – keeping in mind the HS40 Series II will disconnect the compressor when the voltage "it sees" drops below 10 V.

Extended Cable Length	Cable Size (mm2 / AWG)	Vdrop1 on extended cable	Vdrop2 on supplied cable	Total Vdrop	Actual Vbatt when HS40 Series II disconnects compressor
2 m (6 ft)	6 / 9.5	0.36 V	0.36 V	0.72 V	10.72 V
4 m (12 ft)	6 / 9.5	0.72 V	0.36 V	1.08 V	11.08 V *
6 m (18 ft)	6 / 9.5	1.08 V	0.36 V	1.44 V	11.44 V *
4 m (12 ft)	10 / 7	0.42 V	0.36 V	0.78 V	10.78 V
6 m (18 ft)	10 / 7	0.6 V	0.36 V	0.96 V	10.96 V
10 m (30 ft)	10 / 7	1.02 V	0.36 V	1.38 V	11.38 V *
15 m (45 ft)	10 / 7	1.50 V	0.36 V	1.86 V	11.86 V *
15 m (45 ft)	16 / 5	0.96 V	0.36 V	1.32 V	11.32 V *
20 m (60 ft)	16 / 5	1.26 V	0.36 V	1.62 V	11.62 V *

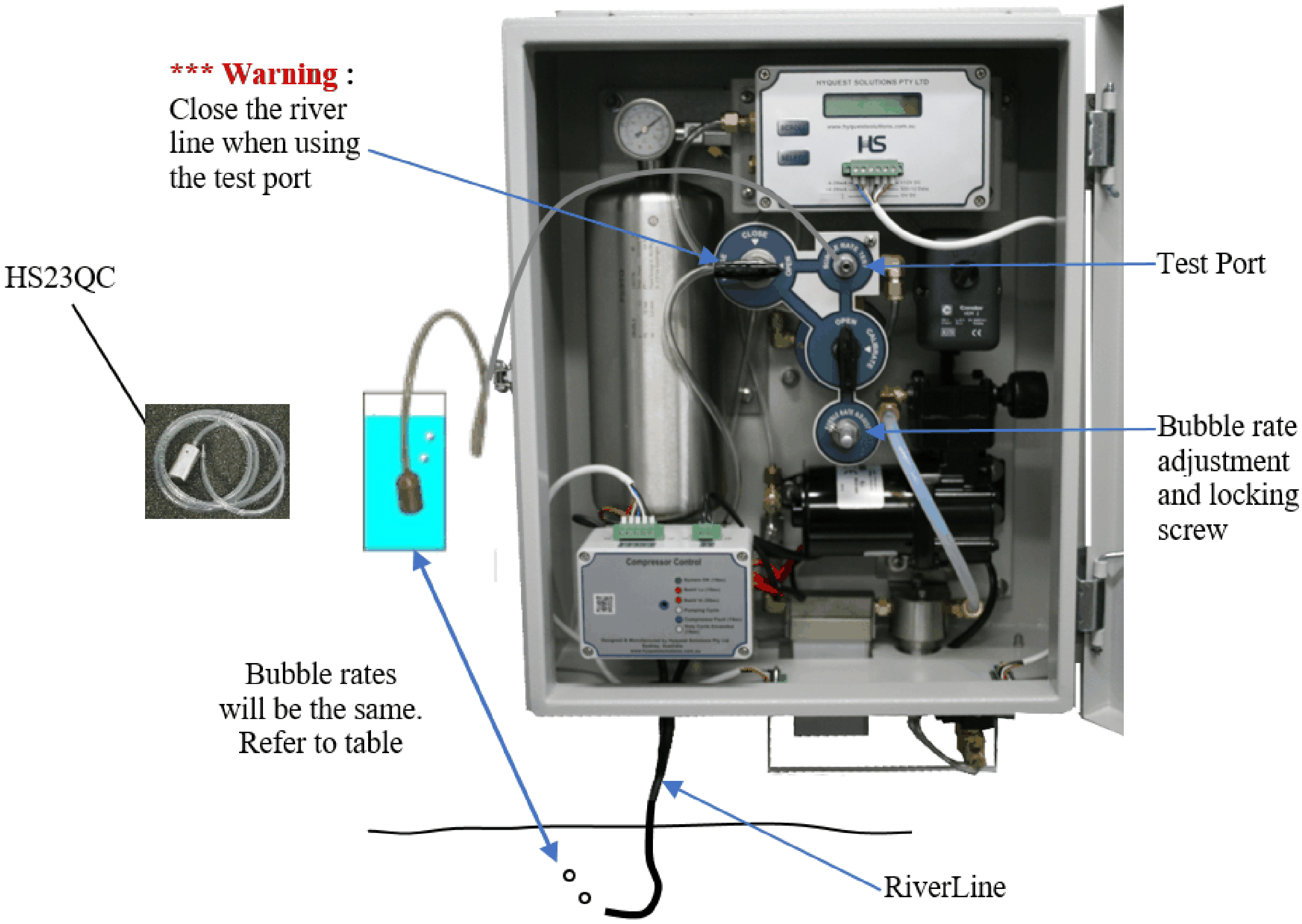
* => Not Recommended

Note: A minimum battery capacity of 38 Ah is recommended, to lessen battery voltage drop under heavy load.

2.2 Adjusting the Bubble Rate

- Set the River Line control valve to the “Close” position. (Keep the Calibrate valve in the “Open” position)
- Attach the HS23QC (supplied as standard) to the HS40 Series II Test Port and immerse the HS23QC in a beaker of water.
- Allow up to 10 minutes for the bubble rate and differential regulator to stabilise.
- Undo the bubble rate lock screw and adjust the bubble rate (to say 21 bubbles/min) The bubble rate at the Test Port will be the same as would be at the River Line orifice. Nip up the lock screw and test the bubble rate again – it may change slightly as the lock screw is done up.
  Caution: Adjustment of the bubble rate higher than the maximum 45 BPM will void the manufacturer warranty on this product.
- Disconnect the HS23QC from the HS40 Series II Test Port.
- Rotate the River Line control valve from the “Close” position to the “Open” position to direct the bubbles from the “Test Port” back to the “River Line”.

<table>
<tr><th>Actual Bubble Rate setting at Test Orifice or River Line (bubbles/min)</th><th>Suitability</th></tr>
<tr><td>10 Bubbles Per Minute.
(Recommended for GCO1P).</td><td rowspan="3">Suitable for Slow rising streams.</td></tr>
<tr><td>16 Bubbles Per Minute.</td></tr>
<tr><td>21 Bubbles Per Minute.</td></tr>
<tr><td>26 Bubbles Per Minute.
Factory Set Rate (Recommended for BU07).</td><td>For medium rising streams.</td></tr>
<tr><td>Maximum do not exceed 45 Bubbles Per Minute.</td><td rowspan="2">Suitable for Fast rising streams.</td></tr>
<tr><td>Exceeding the maximum bubble rate will cause excessive wear to compressor pump.</td></tr>
</table>



2.3 WL3100 Connection

The WL3100 measures the river-line pressure and provides water level information. Wiring connections to the WL3100 are via a 6 way plug-in terminal block underneath the HS40 Series II enclosure. You must have +12 V and 0 V power for the WL3100 to operate. You may connect the SDI-12 and the 4-20 mA interfaces at the same time. (These terminals are "screwless" and keep a constant tension on the wire, thus producing a more reliable connection – simply use a screwdriver to push on the orange lever to release the terminal spring tension, to insert or remove the wire.)

(Consult the WL3100 Manual for a detailed description of the WL3100 connection, operation and specific SDI-12 commands – available on the KISTERS website)

12	+12 V DC Power
Da	SDI-12 Data
0V	0 V DC Power
+S	+ve 4-20 mA Signal
-S	-ve 4-20 mA Signal

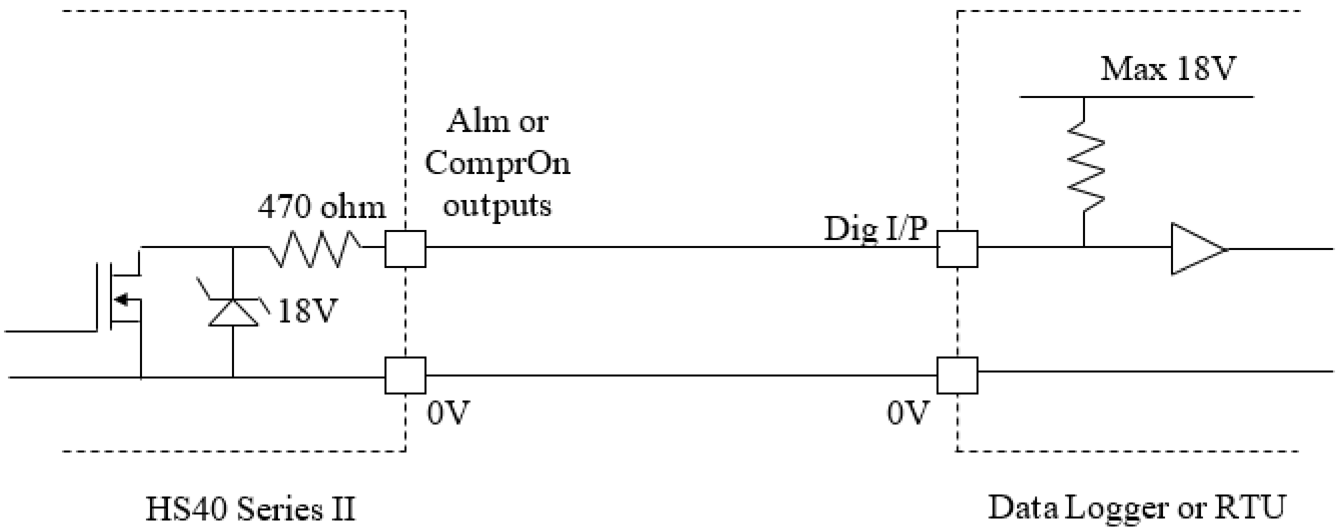
If connecting to the 4-20 mA interface, make sure that the data logger (or RTU) powers up the 4-20 mA loop long enough for the WL3100 to recognize it, take a measurement and put the result back on to the 4-20 mA loop. (1 sec when "Continuous Mode" is set to "YES" and 15 secs when "Continuous Mode" is set to "NO")

2.4 Compressor Diagnostic Interface and SDI-12

The wiring connections to the Compressor Controller is via the 5 way plug-in terminal block underneath the HS40 Series II enclosure, and provides diagnostic information about the compressor. Notice that +12 V is not required at these terminals, as the Compressor Controller is powered from the heavy duty 6 mm^2 cables. (These terminals are “screwless” and keep a constant tension on the wire, thus producing a more reliable connection – simply use a screwdriver to push on the orange lever to release the terminal spring tension, to insert or remove the wire.)

Alm	Alarm O/C Output
CmprOn	Compr O/C Output
0V	0 V Common
SDI	SDI-12 Data
0V	0 V Common

This interface provides 2 x open collector style outputs that may be wired directly to a data logger or RTU digital inputs, indicating when the compressor is operating (CmprOn), and if an alarm condition is present (Alm). The equivalent circuit is shown below:



SDI-12 is a standard used in the Hydrography industry for interfacing data recorders with microprocessor-based sensors. **SDI-12** stands for **S**erial/**D**igital **I**nterface at 1200 baud.

The SDI-12 interface provides further diagnostic information such as :

- System status – All OK, pump cycle in progress, compressor problem, Batt LV / HV.
- How long the compressor was on for (in secs), during the last compressor pump cycle.
- The time (in mins) since the compressor last operated.
- Number of times the compressor has operated in the last 24 hours.
- The min battery voltage during the last compressor pump cycle.
- The max current during the last compressor pump cycle.
- The present battery voltage.

SDI-12 Mode

The SDI-12 protocol has very strict ‘break’ and timing requirements – combined with 1200 baud, 7 bits and even parity. When using a logger with native SDI-12, this timing is handled automatically.

Using RS232 Mode

The SDI-12 in the Compressor Controller has been implemented with a special feature that allows an SDI-12 to RS232 adaptor cable to be used so that communications via RS232 from a PC (or RTU). This special mode is enacted on each command by proceeding each SDI-12 command with an ascii '*' rather than a 'break'. When the ascii '*' is detected, all of the timing/break requirements of the SDI-12 are removed. Commands may be typed from a terminal program such as "Hyperterm".

Note: RS232 mode requires each SDI-12 command to be preceded with a *

Note: If using Hyperterm à 1200 baud, 7 bits, even parity and no handshaking.

SDI-12 V1.3 Compliant Command Set (CRC commands are implemented)

(Please note the letter 'a' in the commands below refer to the SDI-12 address 0, 1, 2,....9)

Note: The default compressor controller SDI-12 Address 'a' is 9

Name	Command	Response
Break	Continuous spacing for at least 12 milliseconds	None
Acknowledge Active	a!	a<CR><LF>
Send Identification	aI!	allccccccccmmmmmmvvvxxx...xx<CR><LF> (Refer Note 1 12)
Change Address	aAb!	b<CR><LF>
Address Query	?!	a<CR><LF>
Start Measurement	aM! or aMC!	atttn<CR><LF> (Refer Note 2 13)
Send Data	aD0!	a<values><CR><LF> or a<values><CRC><CR><LF> (Refer Note 3 13)
Continuous Measurement	aR0! or aRC0!	a<values><CR><LF> (Refer Note 3 13,4 13) a<values><CRC><CR><LF>
Start Verification	aV!	atttn<CR><LF>
Start Concurrent Measurement	aC! or aCC!	atttnn<CR><LF> (Refer Note 2 13)

Note 1.

a13HydrServHS40SII-1.012345<CR><LF>

- **5 digit Sensor ID (eg 12345)(as set in aXID command)**
- **S/W Revision (eg 1.0)**
- **Model (HS40SII-)**
- **Company ID (HydrServ)**
- **SDI-12 Version V1.3 Compliant**
- **Unit Address**

Note 2.

The measurement command “M” and the concurrent command “C” will both return a time “ttt” of 000 indicating that the measurement will be ready in 000 seconds and ‘n’ is 7 indicating there a 7 variables to be returned. Therefore a service request is not supplied. (In accordance with the SDI-12 protocol).

Note 3.

Typical aD0! or aR0! response

a+0+16+324+1+12.3+33.2+13.0<CR><LF>

- **Present battery voltage (13.0V)**
- **Maximum current during last compressor pump cycle (32.2A)**
- **Minimum battery voltage during last compressor pump cycle (12.3V)**
- **Number of compressor cycles in the last 24 hours (1)**
- **Time in mins since the last compressor pump cycle (324 mins)**
- **Duration in secs of the last compressor pump cycle (16 secs)**
- **Compressor Status (0 => All OK) (See next page for full list)**
- **Unit Address**

Note 4.

The Continuous Measurement command returns the same data as the Measure / Data combination in Note 3.

Compressor Status

The compressor status is retuned in the aM!-aD0! and aR0! commands:

0	All OK.
1	Compressor pump cycle is in progress.
2	Battery voltage low alarm (BattV < 10 V and not risen above 12.5 V yet)
3	Battery voltage high alarm (BattV > 16 V)
4	Compressor pump cycle took too long (> 90 secs) – may be due to a pressure leak. (Another pump cycle will be attempted automatically in 12 hrs)
5	Compressor duty cycle exceeded – (on for 4 mins total in a 15 min period) (May have occurred if too many purges have been performed) (The pump cycle will continue in 10 mins once the compressor has cooled down)

Please note:

For more information on SDI-12 commands, go to the www.sdi-12.org website and download the “SDI-12 Protocol Specification” available on the home page.

Special Commands

The following commands conform to the SDI-12 protocol, and allow specific parameters within the Compressor Controller to be configured.

Set/Get ID Number

aXID!	Get the Compressor Controller ID.	Replies with a+12345<CR><LF>
aXID+12345!	Set the Compressor Controller ID. Any ascii character is acceptable. This value appears in the Identify command.	Replies with a+12345<CR><LF>

Sample SDI-12 (RS232) Session

The following session is using the RS232 to SDI-12 interface to demonstrate the '*' which removes the SDI-12 timing.

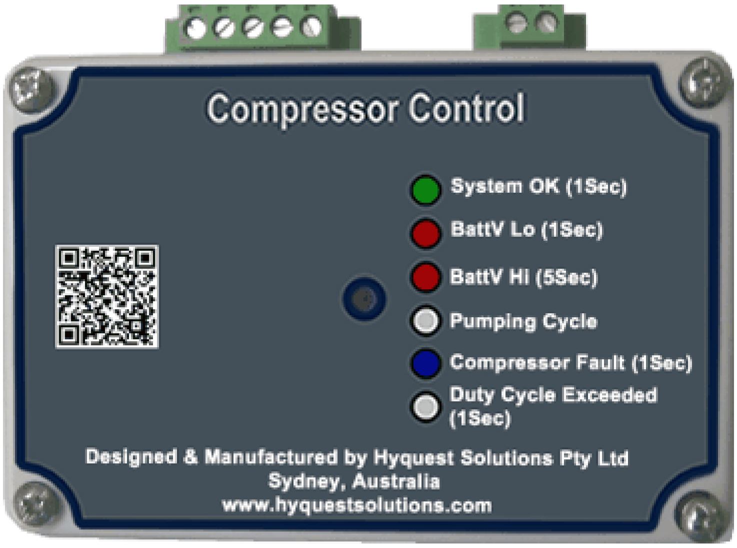
Command	Response	Comment
*9I!	913HydrServHS40SII-1.012345<CR><LF>	Get ID from addr 9
*9A2!	2<CR><LF>	Change address from 9 to 2
*2M!	20007<CR><LF>	Measure request on address 2 (7 variables avail in 000 secs)
*2D0!	2+0+16+235+1+11.8+32.2+12.7<CR><LF>	Get data from address 2 (See data definition on prev page)
*2R0!	2+1+16+243+1+11.8+32.2+11.9<CR><LF>	Contin Meas on address 2 (Same as 2M! and then 2D0!)

3 Operation

This chapter contains the following subsections:

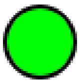
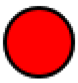
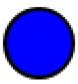
3.1 Description of Indicators

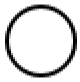
When power is first applied, the Compressor Controller LED will flash each colour as a test – then the compressor may start a pump up cycle, depending on the tank pressure and the state of the Condor pressure switch.



During normal operation, the status LED has the following meaning:

Status LED indicator:

	Flash 1/sec (=1 Hz) => Everything is operating normally. (Compressor + battery)
	Flash 1/sec (=1 Hz) => Battery voltage is low. (If the battery voltage falls below 10 V, the compressor will not operate and the LED will flash red. The LED will only return to a green flash when the voltage rises above 12.5 V. This allows the battery to be charged to a reasonable level by solar, before attempting to operate the compressor again.) Flash 5/sec (=5 Hz) => Battery voltage is high. (If the battery voltage rises above 16 V, the compressor will not operate and the LED will flash red at 5 Hz. The LED will only return to a green flash when the voltage falls below 16 V. This protects the compressor from overvoltage.)
	Flash 1/sec (=1 Hz) => The compressor took more than 90secs to pump up to full pressure. Possible causes are: ▪ Could be due to a leak in the tank / tubing. ▪ The solenoid valve (normally open) is not operating or sealing properly during a pump up cycle. ▪ Compressor has lost its capacity to pump. ▪ Compressor Controller is faulty, and not switching enough power to the compressor itself or the in-line compressor connector is loose. **Note**: Even when the LED is flashing blue, the system will attempt to pump up the tank every 12 hours.

	Steady => A pump up cycle is in progress. Flash 1/sec (=1 Hz) => The compressor on/off duty cycle has been exceeded. The compressor has been on for more than 4 minutes in the last 15 minutes. Wait 10 minutes for the compressor to cool down, and it will automatically start again to complete the pump up cycle.

River Line Control Valve:

This Control Valve has 3 positions:

Open	In the Open position, the bubbler (regulator) is open to the River Line port and the transducer.
Close	In the Close position, the bubbler (regulator) is closed to the River Line. (If there is nothing plugged into the Test Port Quick Connect, the transducer pressure will continue to increase very slowly as the regulator reacts to a closed system – DO NOT leave it in this position for extended periods as the internal pressure build up may exceed the burst pressure of the transducer element!) **Note**: The cabinet door has an interlock that prevents the door from being closed while the valve is in the “Close” position.
Purge	In the Purge position, the receiver tank is directly connected to the River Line port to allow a Purge of the River Line. After a River Line Purge is performed, rotate the control valve back to the Close position and wait until the River Line pressure drops to a normal level (say 5 seconds) before rotating the control valve back to the Open position. (Otherwise the Purge pressure may be introduced to the transducer and cause damage!)

Important: When purging, **STOP** when the tank pressure falls below 400 kPa, otherwise the river-line pressure may fall below the water head pressure resulting in water entering the River Line!

Calibrate Valve:

The Calibrate Valve is used to allow the “Bubble Rate Test Port” to be used to check the transducer (WL3100) calibration. The procedure is as follows:

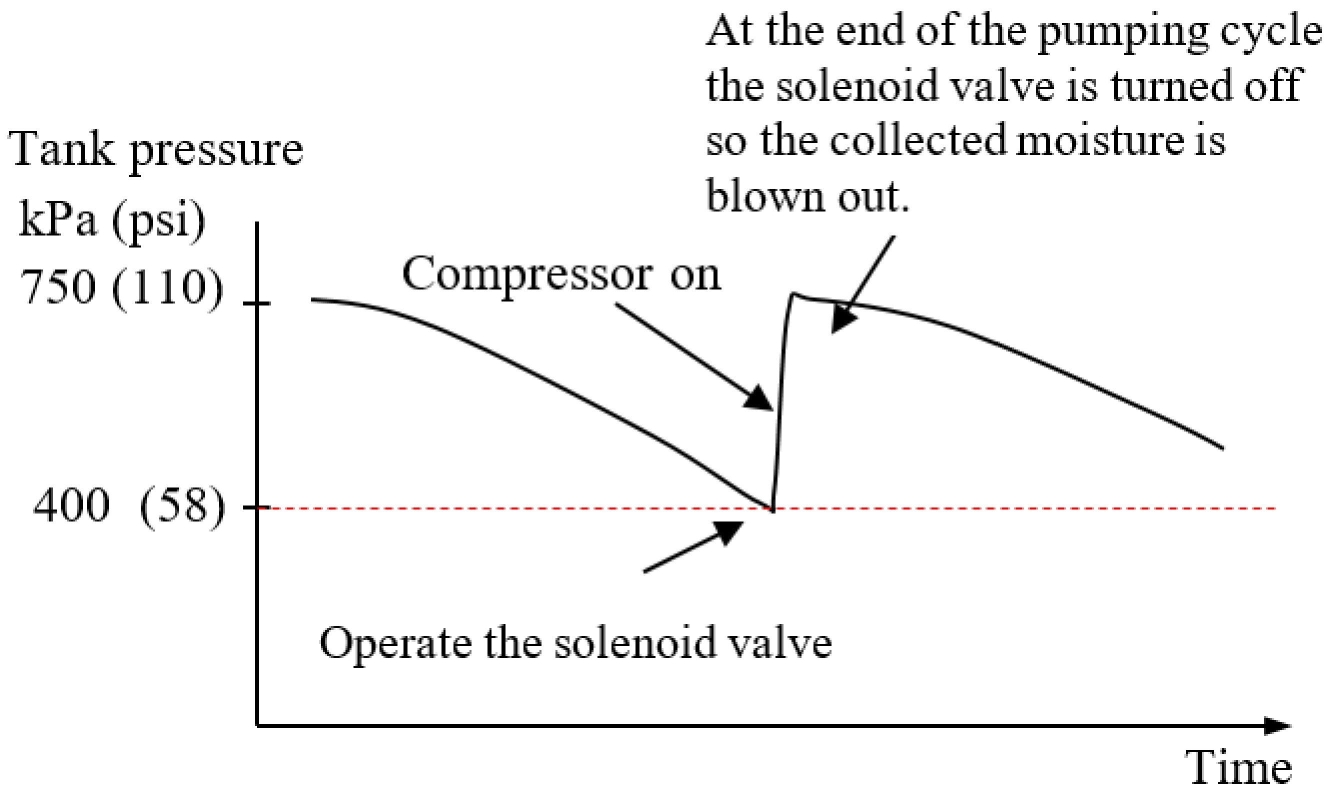
- Set the “River Line Select” valve to the Close position.
- Set the “Calibrate Valve” to the Calibrate position.
- Set the pump up calibrator to “vent” so that the existing water head pressure is vented during the next step.
- Connect the pump up calibrator to the Bubble Rate Test Port using the calibration hose assembly (can be purchased separately from KISTERS if required).
  The pressure from the pump up calibrator can now be applied directly to the transducer (WL3100) input. Set a required pressure (or water level) on the pump up calibrator, then read the water level from the transducer (WL3100). After the transducer calibration has been verified, the system can be returned to normal operation by:
- Remove the pump up calibrator from the Bubble Rate Test Port
- Set the “Calibrate Valve” back to the Open position.
- Set the “River Line Select” valve back to the Open Position.

3.2 Startup Sequence

After power-up the Compressor Controller status LED flashes all 3 colours, Green then Red then Blue to confirm the LED is working OK.

3.3 Tank Pressurisation & Mist Separator Flushing

When the tank pressure falls below 400 kPa (58 psi) [±20%], the Condor pressure switch will close, causing the controller to operate the solenoid valve and initiate a compressor soft start. The compressor will then pump the pressure back up to 750 kPa (110 psi) [±20%]. (While the compressor is on, the LED will be steady white. At the end of the pump up cycle, the LED will flash green if completed successfully, or flash red or blue if there is a problem. At the end of each pumping cycle, the solenoid valve is turned off so the collected moisture is blown out of the micro mist separator to atmosphere.



3.4 Battery Size

The HS40 Series II consumes a quiescent of about 6 mA and draws about 30 A for 16 secs every 18 hours when the rate at the test orifice is set to 26 bubbles/min.

This averages to: 30 A x 16 secs / (18 hr x 3600 secs/hr) = approx 8 mA.

The total average current is therefore:

HS40 Series II quiescent	6.0 mA
HS40 Compressor average	8.0 mA
WL3100 average	5.0 mA
Total consumption	19.0 mA

A 38 Ah battery will run for 38 Ah / 19.0 mA = 2000 hrs = 83 days = 2.6 months

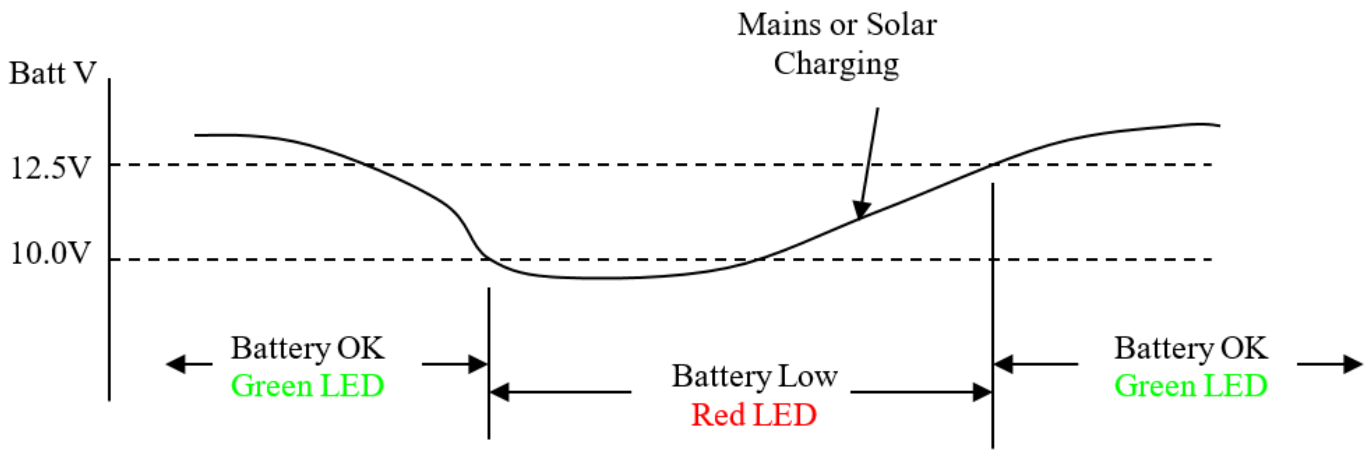
(without any solar or additional charging)

The battery endurance will be dependent on the following:

- The consumption of other equipment connected to the battery.
- The frequency that the system wakes up to take a measurement.
- The length of time the system is awake for each measurement.
- The selected bubble rate – the higher the bubble rate, the more often the compressor will be required to replenish the tank.
- The battery Ah capacity – the minimum recommended battery capacity is 38 Ah.

3.5 Battery Indication

The battery voltage is monitored during all phases of operation. If the battery voltage falls below 10.0 V then the status LED will show the battery low indication and all compressor operation will stop immediately. The battery voltage must then rise above 12.5 V before clearing the battery low condition.



A green LED flash indicates the battery is OK, a red LED flash indicates the battery low indication has been tripped. Once the battery voltage rises above 12.5 V the battery low condition will be cleared and the status LED will return to a green flash.

A pump up cycle will be aborted if a battery low condition occurs. This condition is most likely to occur when the compressor is on because it draws approximately 30 A when operating – causing the battery voltage to drop.

A compressor soft start feature allows the compressor to slowly ramp up to speed, limiting the initial peak current draw which always occurs when motors start up. This also helps prevent a battery low condition being registered as the compressor starts.

4 Maintenance

The HS40 Series II requires little maintenance, however a yearly check of the micro mist filter element is recommended to check the condition of the filter and replace if necessary (see Automatic Moisture Extraction 19). You will also need to ensure that your battery / power supply is sufficient for the equipment that you have installed and that both your battery and charging system are working correctly (see Specification page).

Note:

- All fittings must be secure.
- Even a minor leak will prevent the pressure from being maintained.

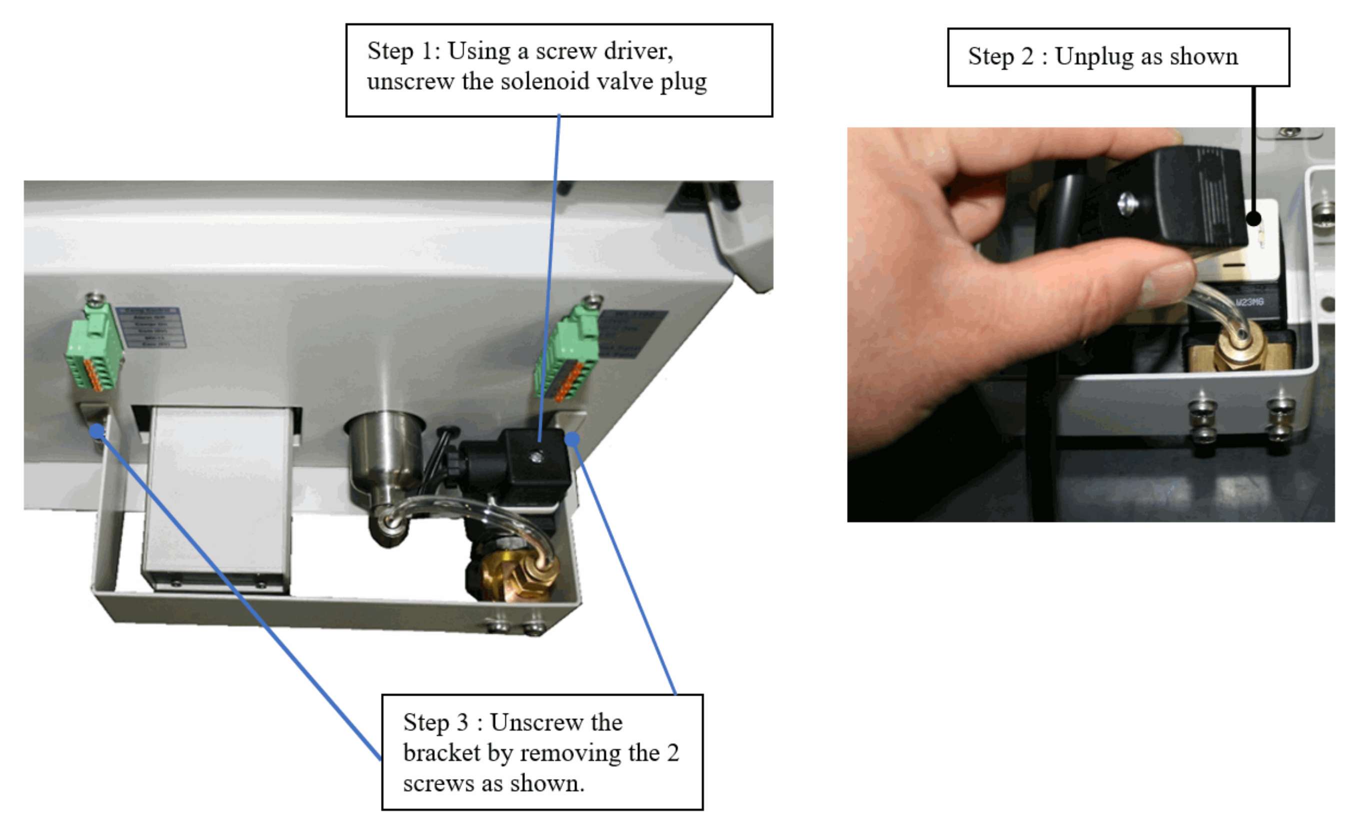
For more information, see the following subsection:

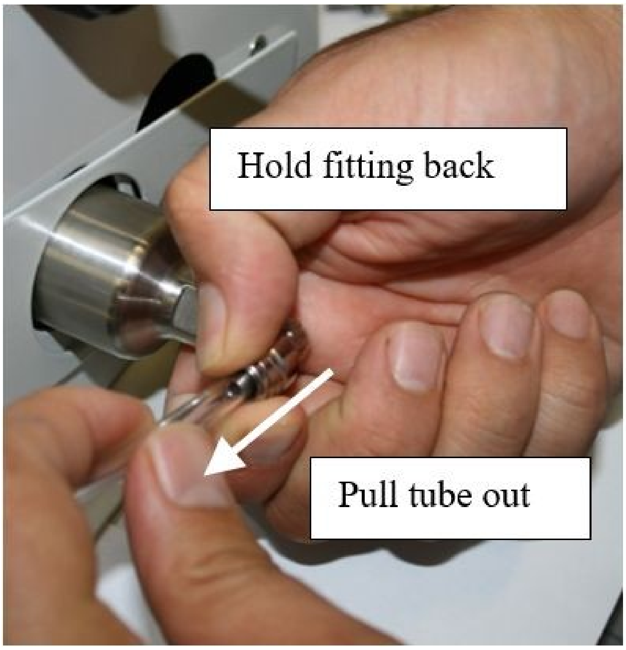
- Automatic Moisture Extraction 19

4.1 Automatic Moisture Extraction

All HS40 Series II models have a system that automatically purges any built up moisture in the micro mist separator, at the end of the pump up cycle, by controlling a solenoid release valve.

Filter Maintenance for the HS40 Series II





Step 4: Hold the fitting back and pull tube out to separate from filter housing

Step 5: Undo filter housing by turning anti-clockwise. (A spanner may be required to loosen)

Step 6: Remove filter housing & ensure O'ring is in good condition.

Replace O'ring if needed
Part No. SC024-55

Step 7: Remove filter by turning anti-clockwise.
Replace filter if needed
Part No. SC023-142

Step 8: Clean filter housing cap if required.

Note: Reverse step 7 to step 1 to re-assemble.

5 Troubleshooting

This fault finding guide should be used by the HS40 Series II user before they consult KISTERS to assist with specific problems.

HS40 Series II Not Powering Up

- Check battery voltage.
- Check battery POWER and GROUND connections to the battery – make sure they are done up tightly and there is no corrosion.

The compressor doesn't start when I connect the power

- Check the state of the Condor pressure switch, and make sure it is set to the '1' position.
- The compressor should only start if the pressure is below 400 kPa – or the HS40 power was disconnected before it had reached the 750 kPa level (maybe it stopped due to battery LV, or pressure leak and then the battery was disconnected.)
- If the Compressor Controller LED is not flashing at all, check the power connections to the battery are firmly done up, and there are no signs of corrosion – clean, retighten and retry.
- If the LED is on steady white, the controller is attempting to turn on the compressor – check the in-line plug connector to the compressor is firmly connected.
- If the LED is flashing red, blue or white, check the steps listed below under "LED is flashing red/blue/white".

The compressor doesn't start when the pressure falls below 400 kPa (58 psi).

- Check the state of the Condor pressure switch, and make sure it is set to the '1' position.
- If the LED is not flashing, check the battery voltage, and check the battery connections for signs of corrosion – clean, retighten and retry. Remove the controller from the battery, and then connect it again, to see if a reboot fixes the problem.
- If the LED is flashing red, blue or white, check the steps listed below under "LED is flashing red / blue / white".
- If the LED is flashing green, then it could be a fault with the controller. Remove the controller from the battery, and then connect it again, to see if a reboot fixes the problem.

The compressor starts but then cuts out before 750 kPa (110 psi) is reached.

- Check the LED flash colour after the compressor stops – if it is flashing red, blue or white then follow the steps listed below.
- If the LED is flashing green then maybe the Condor pressure switch has cut off too early – if you hear a loud click when the compressor switches off, then the Condor switch is stopping the compressor before 750 kPa has been reached. Contact KISTERS to obtain instructions for resetting the Condor pressure switch limits.
- Maybe there is a fault with the compressor controller. Try cycling the Compressor Controller power, to see if a reboot fixes the problem.

LED is flashing red (1 flash/sec).

- If the LED is flashing red (1 flash/sec), then it has detected a low battery voltage. This could be due to the battery voltage drooping below 10 V as the compressor starts and draws the required 30 A. (If you are measuring the battery voltage at the battery itself, it may be lower at the HS40 Series II due to cable and connection voltage drops.)

  Check the following:
- Check the battery has been sufficiently charged – the voltage must rise above 12.5 V before the LED will flash green again.
- Check the battery connections are done up securely and there is no corrosion.
- Check the battery capacity is sufficient (an absolute minimum of 12 V 38 Ah is required).
- If using a power supply instead of a battery, it may be going into current limit with the compressor start current – check the power supply specifications.
- Check the HS40 Series II power wiring is connected directly to the battery. (If the HS40 Series II has been connected to the Solar Regulator load terminals, there may be a large voltage drop through the regulator as the HS40 Series II compressor starts and draws 30 A.)
- If the HS40 Series II power wiring has been extended, make sure the cable sizes specified in the manual have been followed, otherwise cable voltage drops will occur when the compressor starts and draws 30 A.

LED is flashing red (5 flashes/sec).

- If the LED is flashing red (5 flashes/sec), then it has detected a high battery voltage > 16 V. This could be due to the battery being disconnected, and the system voltage being supplied by the solar alone. The HS40 Series II will not be damaged when connected to a voltage up to 30 V DC – but it will only operate when the voltage is less than 16 V – otherwise the compressor itself may be damaged.

LED is flashing blue (1 flash/sec).

- The compressor has tried to pump up the tank, but the pressure is not increasing, or the overall cycle pump up time of 90 secs has been exceeded, so the compressor is stopped assuming there is a leak somewhere. When in this state, the compressor will automatically attempt another pump up cycle in 12 hours. If you wish to manually force a pump up cycle, remove the Compressor Controller lid (with the 4 x ¼ turn screws) and press the small black button on the top RHS of the top circuit board. (This button will only force a cycle when the LED is flashing blue.)
- Make sure the Condor pressure switch is set to the “1” position.
- Make sure the control valve is not in the “Purge” position.
- Check the in-line connector to the compressor is firmly plugged in.
- Check the power to the solenoid valve is plugged in – on the valve itself and also at the controller. If it is not connected, you will hear (and feel) air escaping from the valve.
- Check the sealing of the micro mist separator cylinder at the bottom of the cabinet – listen for air leaks – maybe they are not seated properly.
- If everything else looks OK then check the internal tube connections for leaks by spraying a bubble solution on all internal fittings. Tighten or repair the leaking fitting.
- If there are no leaks, there may be a problem with the compressor itself, not building up enough pressure.

LED is flashing white (1 flash/sec).

- The compressor duty cycle has been exceeded !
- You have possibly done several purges consecutively exceeding the 4 minute compressor operation in a 15 minute interval – wait 10 mins until the compressor cools down and the LED flashes green and it will automatically retry.

The compressor doesn’t stop at 750 kPa (110 psi)

- There is a fault with the Condor pressure switch adjustment. Contact KISTERS for the adjustment procedure.

6 Repair

KISTERS precision instruments and data loggers are produced in quality-controlled processes. All KISTERS production and assembly sites in Australia, New Zealand and Europe are ISO 9001 certified. All equipment is factory tested and/or factory calibrated before it is shipped to the client. This ensures that KISTERS products perform to their fullest capacity when delivered.

Despite KISTERS most rigorous quality assurance (QA), malfunction may occur within or outside of the warranty period. In rare cases, a product may not be delivered in accordance with your order.

In such cases KISTERS' return and repair policy applies. For you as a customer, this means the following:

- Contact KISTERS using the Repair Request Form and the Declaration of Contamination made available online:

Region (Language)	**Download Link**
Asia-Pacific (English)	Repair Request Form (APAC) Declaration of Contamination (APAC)
Europe, the Middle East and Africa (English)	Repair Request Form (EMEA) Declaration of Contamination (EMEA)
Germany (German)	Repair Request Form (DE) Declaration of Contamination (DE)

  In response you will receive a reference number that must be referenced on all further correspondence and on the freight documents accompanying your return shipment.
- Please provide as much information and/or clear instructions within the return paperwork. This will assist our test engineers with their diagnosis.
- Please do not ship the goods prior to obtaining the reference number. KISTERS will not reject any equipment that arrives without reference number; however, it may take us longer to process.

Custom requirements for items sent to KISTERS for warranty or non-warranty repairs: Check with your national customs/tax authorities for details, processes and paperwork regarding tax exempt return of products. Typically, special custom tariff codes are available (such as HS Code = 9802.00) that verify the item is being returned for repair and has no commercial value. Please note that the customs invoice / dispatch documents should also clearly state: “Goods being returned to manufacturer for repair – No Commercial value”. It is mandatory to have any returned goods accompanied by a commercial invoice on headed paper. KISTERS reserves the right to charge the customer for time spent rectifying incorrect customs documents.

Note: Please ensure that your goods are packed carefully and securely. Damage that occurs during transit is not covered by our warranty and may be chargeable.

7 Technical Data

Power Supply	12 V dc nominal; power consumption: average approx. 20 mA, peak approx. 30 A (pumping process ≤ 16 sec/18 h).
Diagnostics	An extended SDI-12 (Version 1.3) command set allows the control and retrieval of diagnostic data.
Dimensions (W × H × D)	405 mm × 635 mm × 220 mm
Mass	24 kg
Operating Conditions	Temperature: ▪ -20 °C to +70 °C (HS40/Series II)
	Humidity: ▪ 0–100%
Sensor Accuracy	With pressure sensor WL3100 and correctly determined compensation factor, an accuracy of ±0.02% relative to the full scale value is achieved.
Outputs (for WL3100 models)	Simultaneous data output via 4–20 mA and SDI-12 allows connection of up to two data loggers (redundancy).
Bubble Rate	Factory preset at 26 per minute (at the orifice).
Air Dryer	Auto purge air dryer (solenoid valve) complete with micro mist separator and membrane dryer.

8 Obligations of the Operator and Disposal

This chapter contains the following subsections:

8.1 Obligations of the Operator

European Union

In the Single European Market it is the responsibility of the operator to ensure that the following legal regulations are observed and complied with: national implementation of the framework directive (89/391/EEC) and the associated individual directives, in particular 2009/104/EC, on minimum safety and health requirements for the use of work equipment by employees at work.

Worldwide

Regulations: If and where required, operating licences must be obtained by the operator. In addition, national or regional environmental protection requirements must be complied with, regardless of local legal provisions regarding the following topics:

- Occupational safety
- Product disposal

Connections: Local regulations for electrical installation and connections must be observed.

8.2 Dismantling / Disposal

When disposing of the units and their accessories, the applicable local regulations regarding environment, disposal and occupational safety must be observed.

Before dismantling

- Electrical Devices:
  - Switch off the units.
  - Disconnect electrical appliances from the power supply, regardless of whether the appliances are connected to the mains or to another power source.
- Mechanical devices:
  - Fix all loose components. Prevent the device from moving independently or unintentionally.
  - Loosen mechanical fastenings: Please note that appliances can be heavy and that loosening the fastenings may cause them to become mechanically unstable.

Disposal

Operators of old appliances must recycle them separately from unsorted municipal waste. This applies in particular to electrical waste and old electronic equipment.

Electrical waste and electronic equipment must not be disposed of as household waste!

Instead, these old appliances must be collected separately and disposed of via the local collection and return systems.

Integrated or provided batteries and accumulators must be separated from the appliances and disposed of at the designated collection point. At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions.

EU WEEE Directive

As players in the environmental market, KISTERS AG is committed to supporting efforts to avoid and recycle waste. Please consider:

- Avoidance before recycling!
- Recycling before disposal!

This symbol  indicates that the scrapping of the unit must be carried out in accordance with Directive 2012/19/EU. Please observe the local implementation of the directive and any accompanying or supplementary laws and regulations.

9 Appendices

This chapter contains the following subsections:

9.1 Appendix A Installing Polyethelene Tubing and Orifice Fittings

General

The polyurethane tubing is available in 100, 200 and 300 metre rolls.

It is an extremely durable material that has been used successfully in this application world wide for many years. The tubing is flexible, easy to handle and can be cut with a knife.

The orifice fitting is comprised of a moulded polythene threaded cap, an orifice outlet and a tube fitting. The moulded cap will screw onto a standard 50 mm nominal bore galvanised pipe.

Orifice Fittings

The site and reference level for the orifice fittings should be resolved before installation proceeds. The length of tubing from the HS40S2 to the orifice should not exceed 200 metres. A suggested method for installation of the orifice fitting is shown below. The site of the orifice should be positioned in quiet water out of the mainstream to provide protection. The area should be free of silting and aquatic growth. The mounting for the orifice fitting should consist of a section of 50 mm nominal bore galvanised pipe threaded at one end and secured at the appropriate reference level. The securing of the orifice mounting should be such that it can withstand the forces applied by the flowing stream and associated floating debris.

Preparation of Orifice Tubing

Do not open the carton or remove the strapping. To prepare the roll of tubing for use, cut a 300 mm diameter hole in the centre of the cardboard carton, retrieve the end of the tubing from the middle of the coil, then cut the strapping retaining the coil. This method will reduce the possibility of tangling the tubing. Prevent the ingress of dirt etc. from entering the tubing, by taping up the ends. At no time should the open end of the tubing be permitted to contact the soil.

Orifice Tubing

It is recommended that a trench be dug (minimum 600 mm deep) between the equipment shelter and the proposed positions of the orifice.

The trenches should not have any low points in their length, they should have a continuous fall to the river.

Pull the free end of the coiled tubing to the orifice position laying the tubing in the trench as you go. Refer to diagrams below.

Remove the protective tape from the end of the tubing, and push the tubing through the 50 mm nominal bore pipe mounting. Insert the tubing into the tube fitting on the rear of the orifice fitting, ensuring that both ferrules are in place. Tighten the fitting nut. (Refer to the following diagram for tightening procedure). Place the orifice fitting onto the mounting pipe and tighten.

Cut the tube at the coil end (tape both ends), ensuring that there is sufficient length to make the joint at the HS40S2 within the shelter.

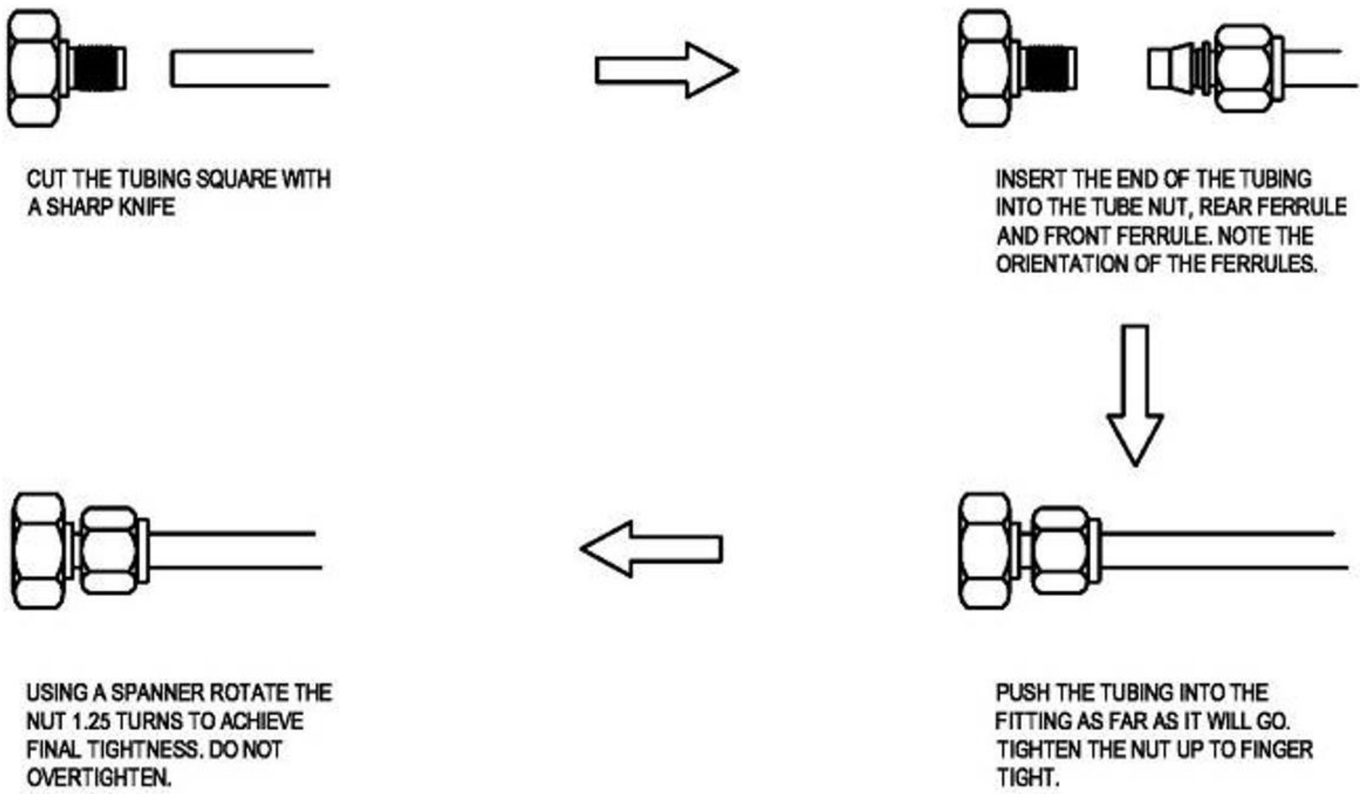
Check the lay of the tubing in the trench to ensure that it is free of coils and kinks. Under no circumstances should the tube form hollows where moisture can be trapped within the tube.

Lay the tubing into position in the equipment shelter as required.

Remove the protective tape from the end of river line tube.

Insert the end of the tube into the appropriate river line fitting on the HS40S2 and tighten both fittings. (Refer to diagram for tightening procedure).

Open the valve to the orifice.



TYPICAL TIGHTENING PROCEDURE FOR RIVERLINE FITTINGS

9.2 Appendix B Using Pressure to Measure Water Level

Gas Purge Principle

The behaviour of a gas flowing under a variable back pressure is utilised as an accurate means of measuring liquid head.

Provided that:

1. The density of the gas is nearly the same as air.
2. The velocity of gas is low enough so as not to produce significant pressure drop down the line then the system pressure will be equal to the back pressure.

This principle is illustrated in the following series of diagrams.

In the first example, the tube exhausts to atmosphere and hence the water manometer indicate zero pressure in the system because it is acted on by two equal pressures- the system pressure and the atmospheric pressure

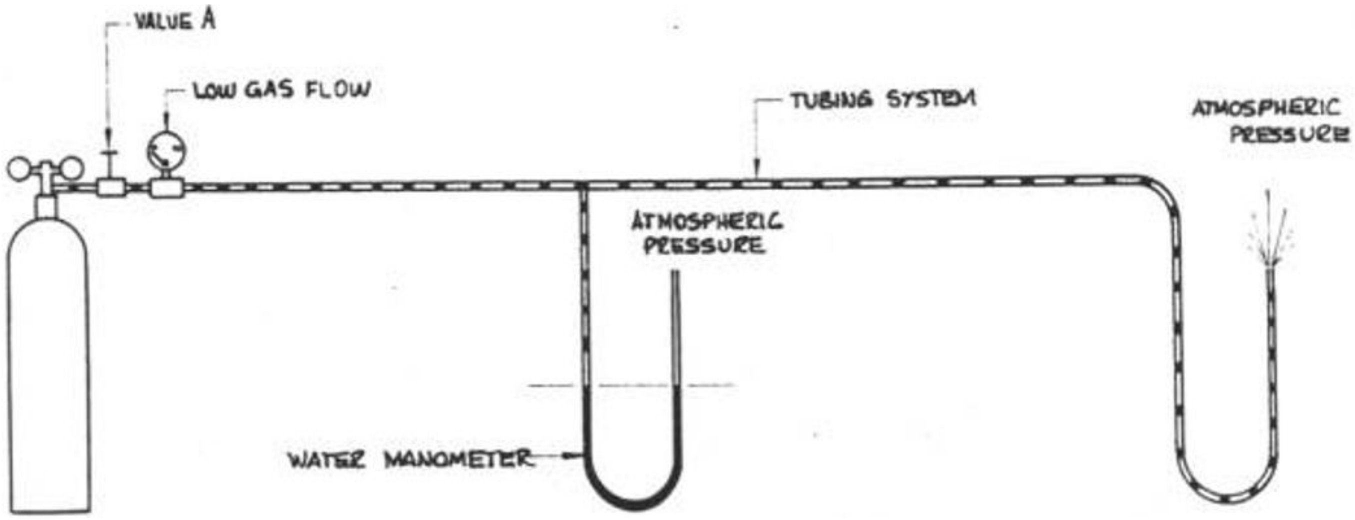


Figure 1 – Depicts first stage in application of gas purge principle

Fig. Depicts first stage in application of gas purge principle 31 - Depicts first stage in application of gas purge principle

Fig. Depicts first stage in application of gas purge principle 31 also illustrate another feature of all pressure systems, namely the gas endeavours to escape through any material that it is in contact with to find a lower pressure, but for practical purposes, the system pressure reflects the lowest of the outlet pressures. In this case, gas endeavours to pass through the walls of the tubing and fittings, through the water, but elects to take the easier path to atmosphere, which is in effect a "massive leak".

Therefore, it follows that in any pressure system that can exhaust to atmosphere, either through a valve or by a large leak, the system pressure is atmospheric and will not reflect any other pressure.

Provided air or a gas that has a very similar density to air is used, then the errors from this source can be neglected. Nitrogen is preferred as it does not promote the formation of aquatic growth.

The effect of the velocity of the gas can be observed by opening valve A, a higher pressure will be needed to force a high volume of gas through the line, resulting in a pressure drop between valve A and the outlet. Depending on the location of the manometer connection, the manometer will reflect a proportion of this increase in pressure.

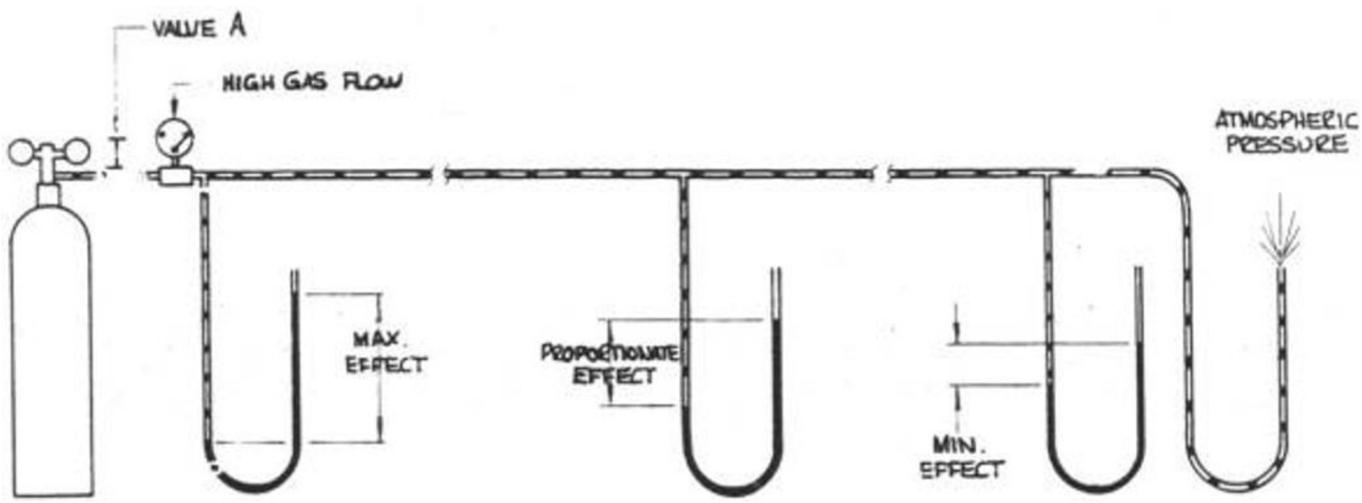


Figure 2 – High gas flow

* Refer "Bubbler System Instrumentation for Water Level Measurement" – Report of Investigation No. 23 state of Illinois, U.S.A

Head To Pressure Conversion

As we are not seeking to measure atmospheric pressure, but liquid head, how is the principle applied?

Simply by using two physical characteristics.

1. The tendency of the gas under pressure to "seek" a lower pressure.

2. The ability of a gas to “pass through” liquids.

The first characteristic has already been demonstrated. The second characteristic can be appreciated by blowing through a hollow tube (straw) that is immersed in water. No bubble will appear until the pressure in the tube is sufficient to expel all the water from the tube.

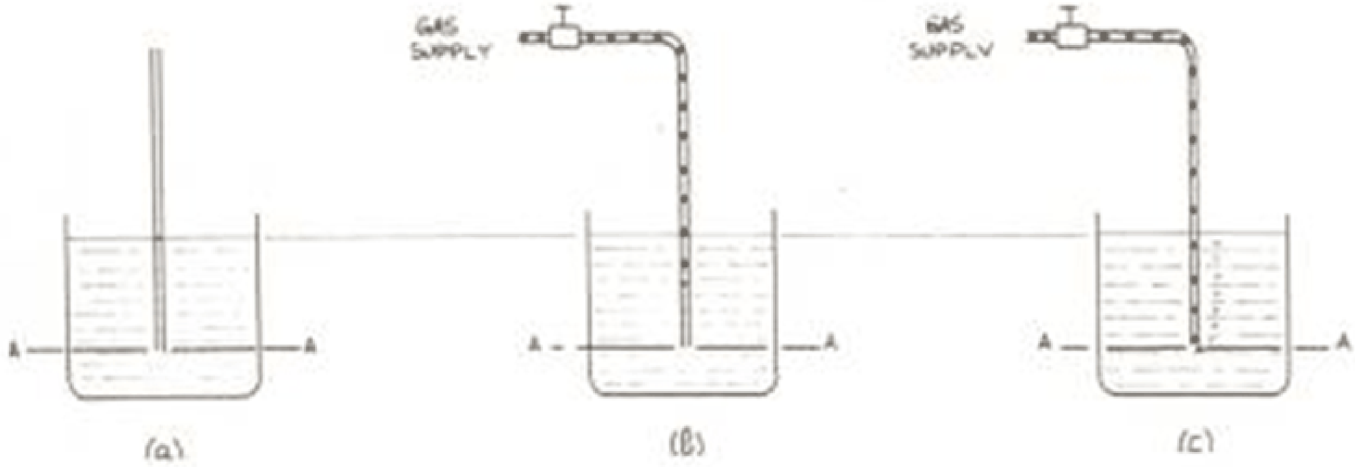


Figure 3

I. If a tube is immersed in a liquid, it can be seen that the pressure at the bottom of the tube is that exerted by the head of liquid above it.
II. If we connect a gas supply to the tube, the gas will act on the surface of the liquid in the tube and tend to force it down. Assuming there is no change in level, the pressure at the end of the tube must be still the same.
III. If we increase the pressure so that the gas can push out all the liquid against pressure level A, then it follows that the pressure at A will be the back pressure in the system. Also the pressure of each bubble of gas as it emerges from the end of the tube will a that point have an internal pressure equal to the head, and this internal pressure reduces until the bubble emerges at the surface at atmospheric pressure.

Therefore the gas acts like a plunger to keep the water out of the tube and in effect, precisely balances the head of water that would naturally occur if the tube was opened to atmospheric pressure.

In other words, the system pressure (back-pressure) is supporting a column of water, equal to the pressure head. Hence, any pressure measuring device, if connected to the pressure system will record the pressure head over the tube outlet (orifice).

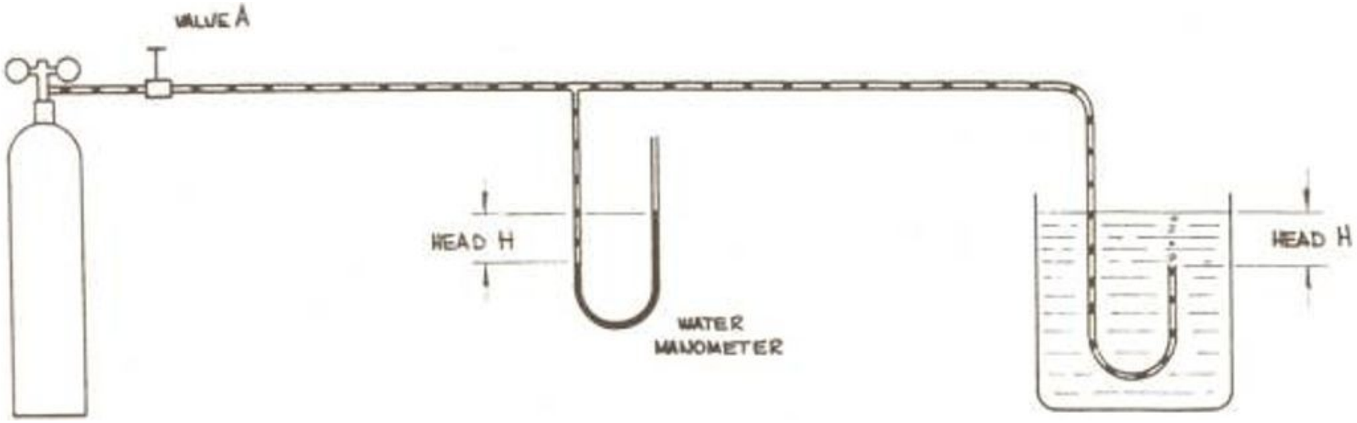


Figure 4 – depicts a water manometer connected to the system and it is recommended that – such an arrangement be set up in a workshop for staff training.

Gas Purge Operational Characteristics

In the foregoing, the discussion has been limited to static head conditions, whereas in practice, the levels in stream are constantly fluctuating.

“Rising” Situations

It is the “rising” or “increasing head” situation that is critical for the correct operation system. Consider a situation where the gas supply is cut off and the level rises- refer Fig. With gas supply cut off. Head increased from H1 to H2, gas is forced down the tube by an amount X 33.

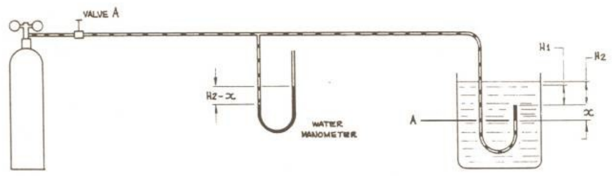


Figure 5 – With gas supply cut off. Head increased from H1 to H2, gas is forced down the tube by an amount X.

In this situation, it can be seen that whilst the system pressure has increased, it is not equal to the new head H2, but rather H2-x. This condition will remain as long as the gas is shut off. In other words, we now have a “closed” system, which respond to changes in accordance with universal gas law.

$$\frac{P_i V_i}{T_i} = a\ constant$$

To revert back to the open system, we must restore gas supply, which will eventually build up pressure in the system, until the gas escape from the orifice and the system pressure again becomes the precise head measurement.

The time taken for the pressure system to respond to a given head pressure is commonly referred to as “follow rate”. The normal procedure is to establish the maximum rate of rise to be measured and adjust the gas flow so that there is no significant lag in the pressure system.

However, in order to conserve the gas supply, the flow rate (bubble rate) is set to the minimum that will meet these conditions.

“Falling“ Situation

The “falling” situation is of course the reverse of the rising situation except that there is now excess pressure in the system. If we were to suddenly lift up the orifice in Fig. 4, the pressure would drop to the new head, seen by the sudden rush of bubbles.

Accordingly, even the lowest bubble rate will suffice for falling conditions.

In practice, it may take some time to the pressure to “bleed away”, but this is usually less than the response time of the sensing unit.

Field Requirement of Gas Purge Systems

The principle requirements of gas purge are :

I. A fine metering valve and sight feed for accurately setting the bubble rate.
II. Constant regulator to maintain a constant bubble rate with changes of head.
III. Pressure connections and valves for connecting the tubing to the river and the instrument.

With the overall provision that the unit must be “leak proof”, otherwise the true head will not be recorded.

The configuration most widely used is shown in Fig 6.

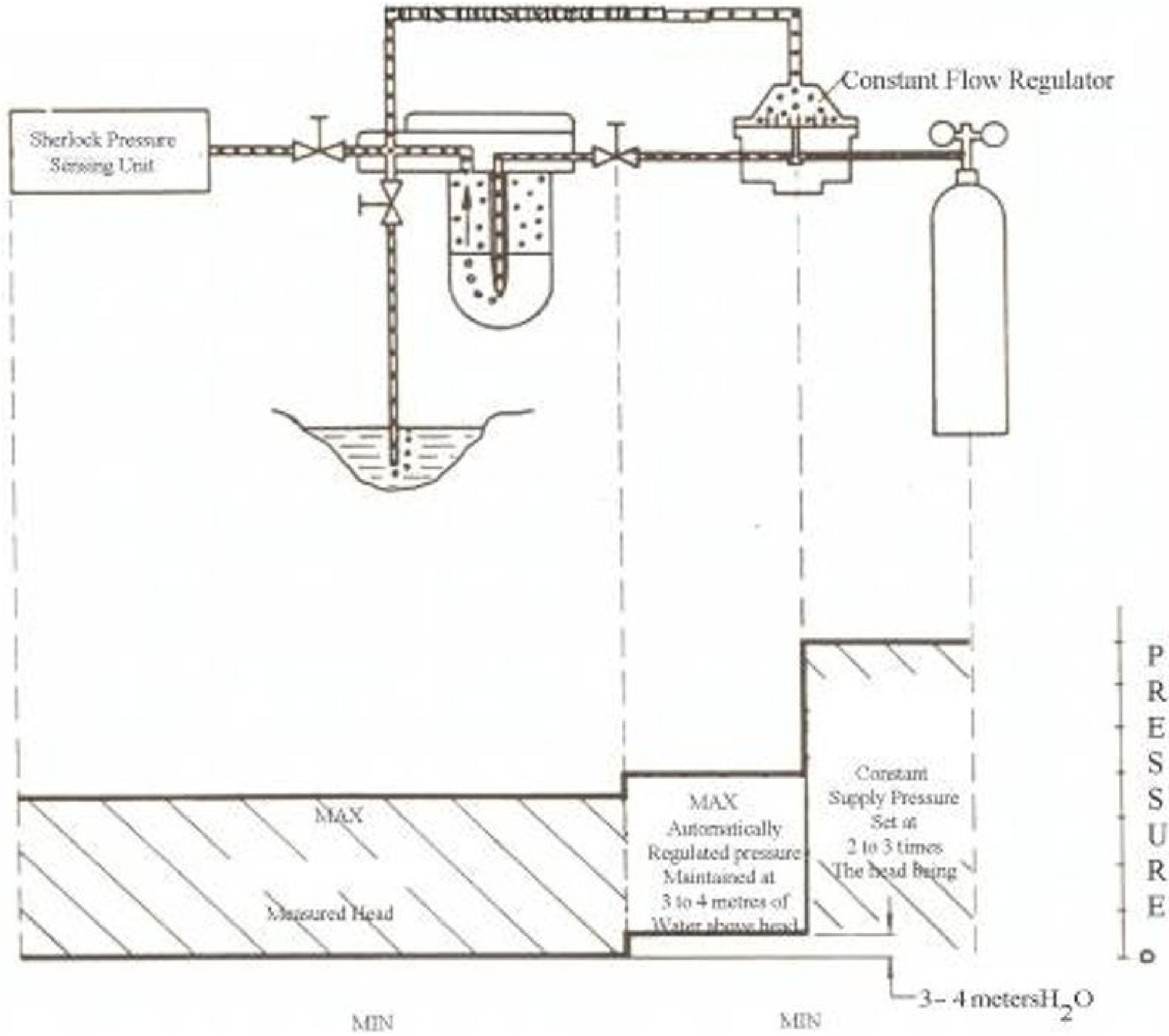


Figure 6 – Diagramatic view of field gas purge, single line without purge facilities.

Dual Line Connections

For long line, the effect referred to in Fig. High gas flow 31 becomes significant and it is usual to make the connection to the system near the orifice, so in effect there are two lines running the orifice. Hence the term dual line.

The operation of KISTERS units is described in more details in diagrams 15 and 16 of "instruction Manual for Sherlock Pressure Sensing Units".

Pressure Bulb or Closed System

The pressure bulb system relies on the normal $\frac{P_i V_i}{T_i}$ = constant relationship for gases under pressure.

Using similar diagrams to before, the closed system can be illustrated follows:-

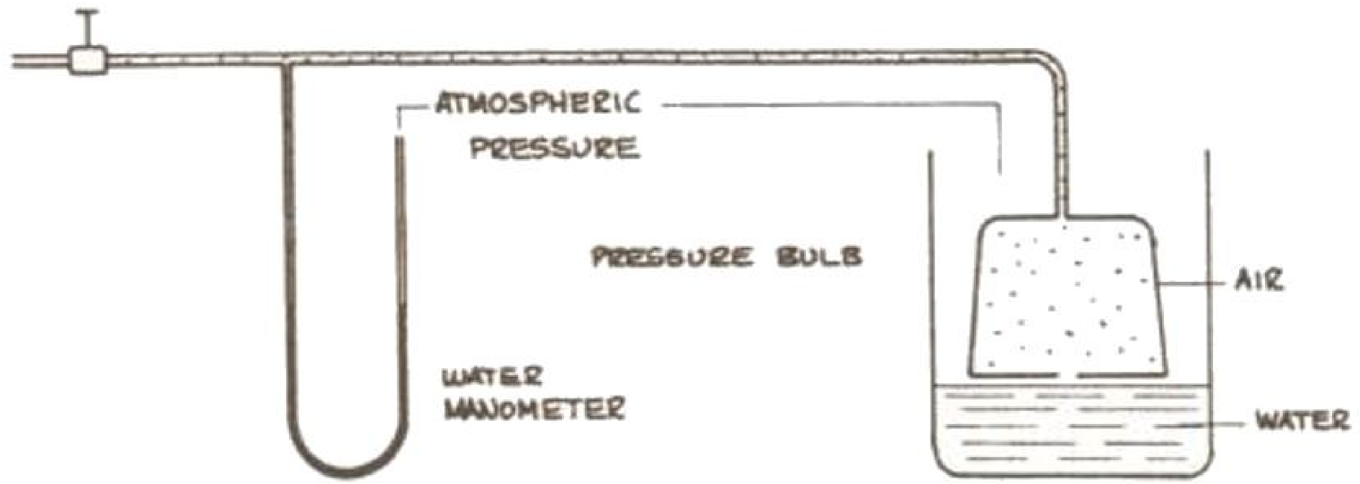


Figure 7 – Atmosphere- up to the level at which the water seals off the bottom of the bulb.

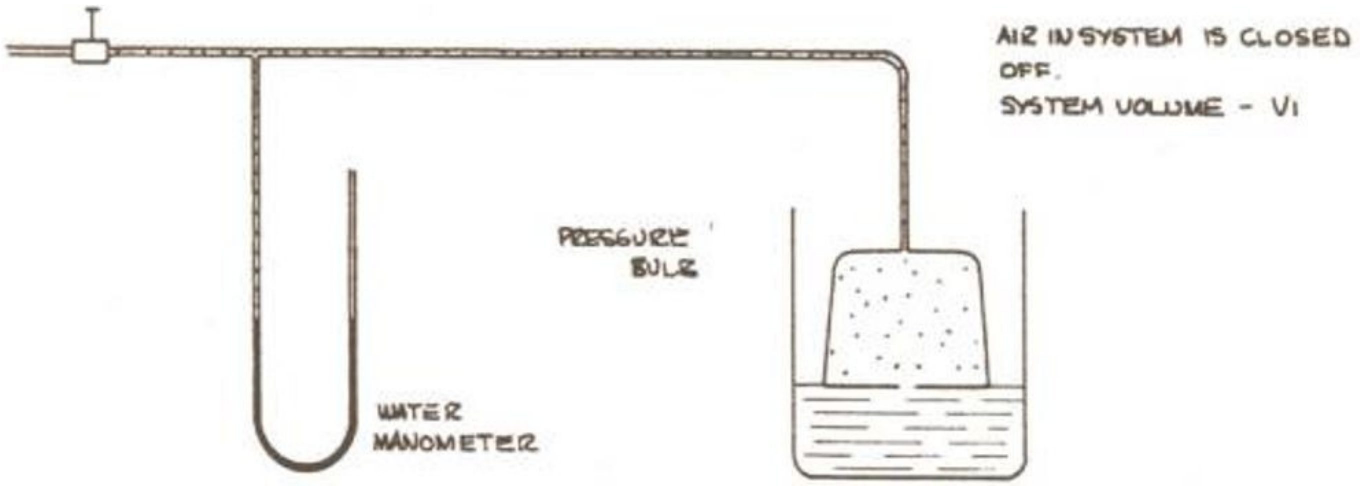


Figure 8 – water seals off air and at this point system pressure is still atmosphere.

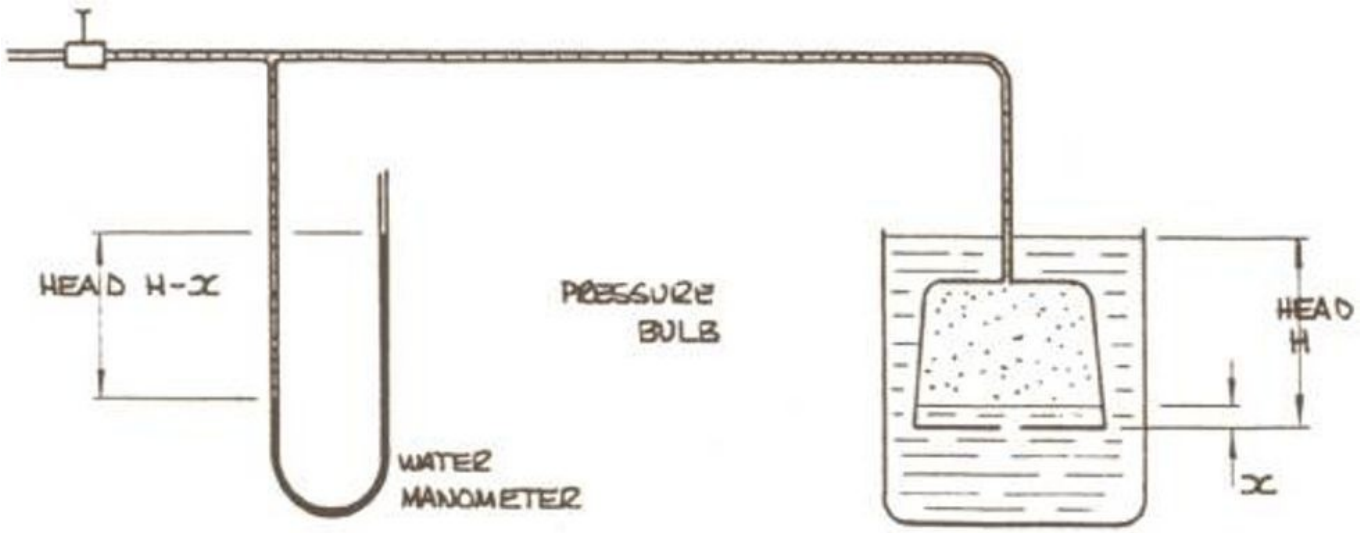


Figure 9: – system operating under head conditions

As the water rises, the system pressure increases to the equivalent of the head H minus the amount the water rises within the bulb.

This amount x, is non-linear and therefore cannot be completely compensated for by simple calibration. Provided the head H does not fall below say 300 mm, error from this cause is minimal.

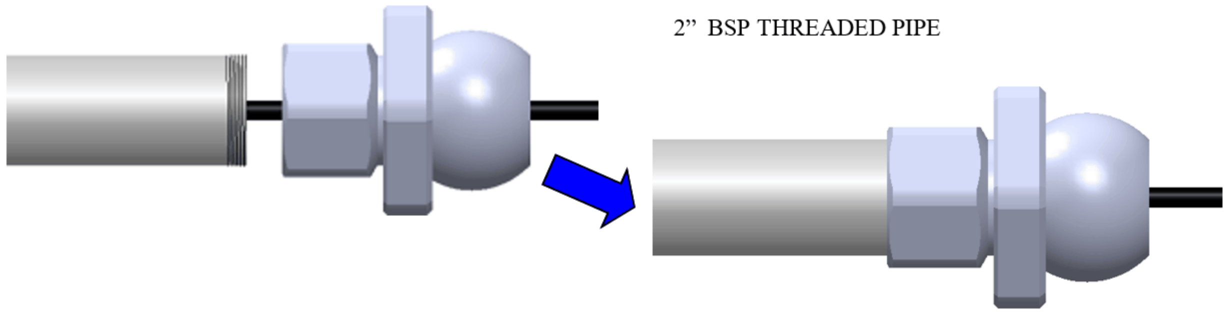
Basically the closed system will give good results subject to gradual changes of water temperature being experienced and the system being completely gas tight.

A full discussion of this principle in given in “Low Cost Stream Height Recorders” - Unisearch (N.S.W) publication.

9.3 Appendix C Gas Chamber Orifice Assembly

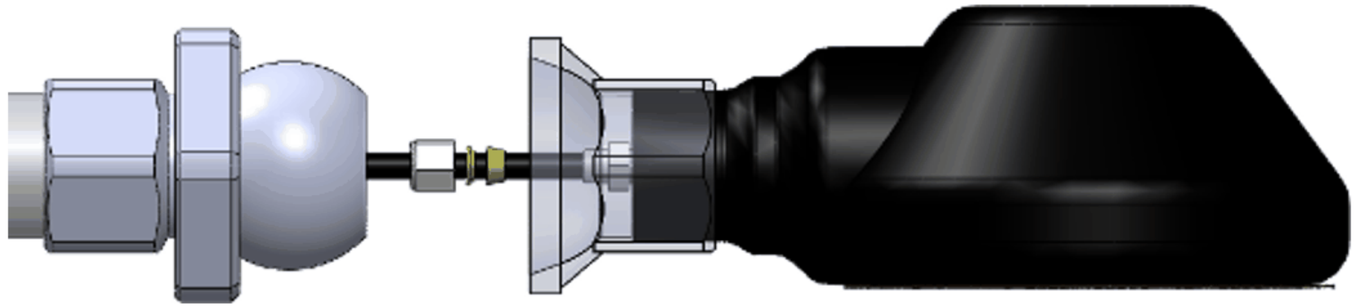
Step 1:

Secure Socket/Locknut to the 2” BSP pipe



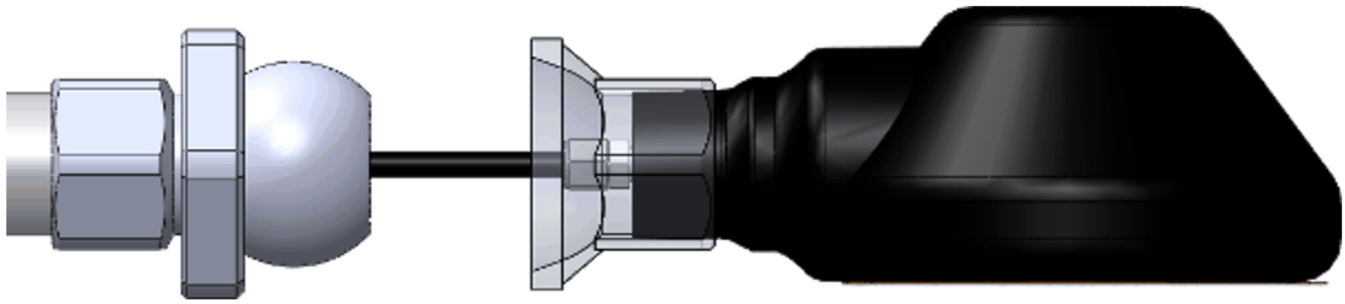
Step 2:

Undo the nut and ferrules; feed the tube nut and the two ferrules onto the river line as shown in figure below



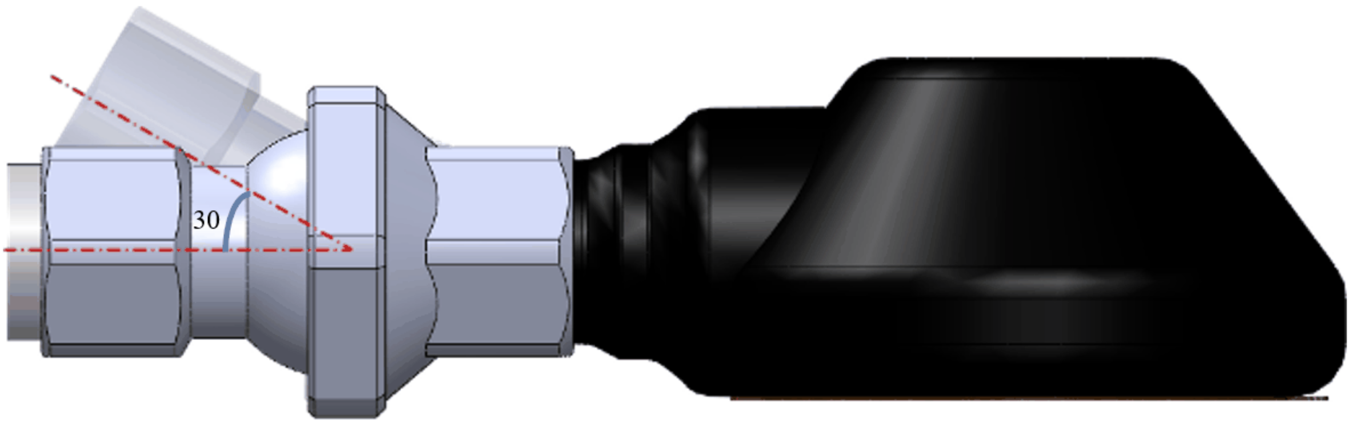
Step 3:

Tighten the tube nut to the GCO1 fitting as shown in figure below



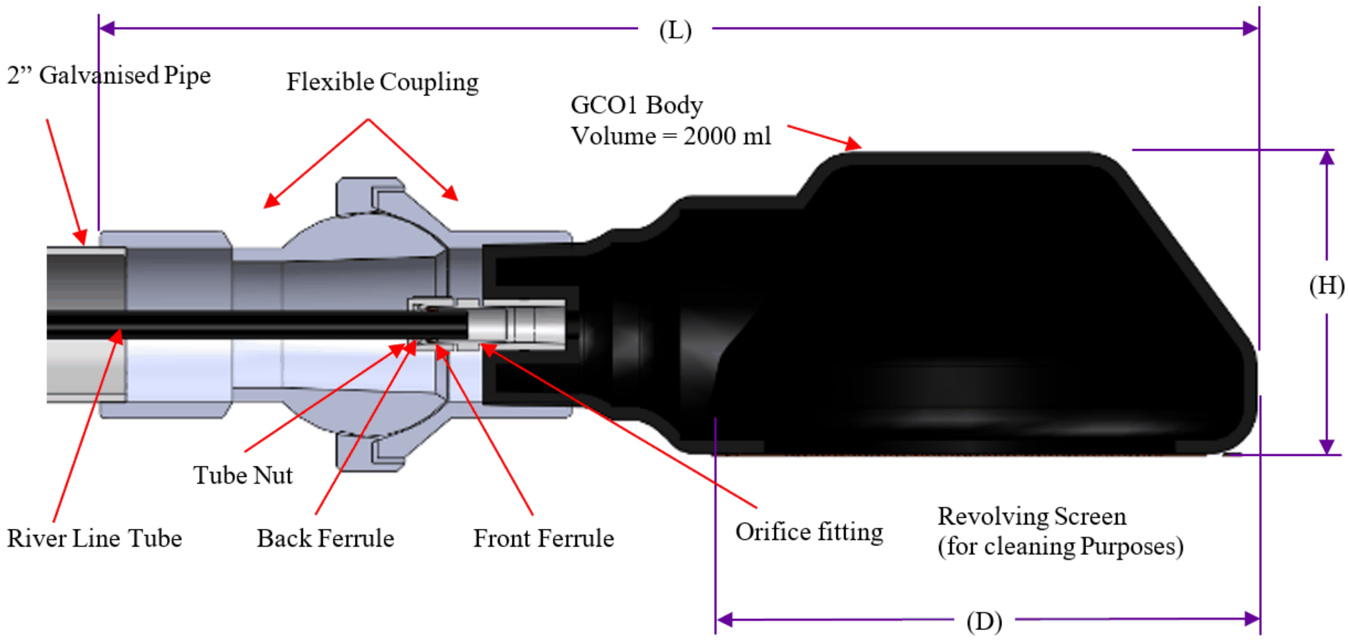
Step 4:

Place the GCO1 assembly onto the mounting pipe, adjust coupling so the GCO1 is horizontal to the water, and tighten the flexible coupling with GCO1 in position.



Note:

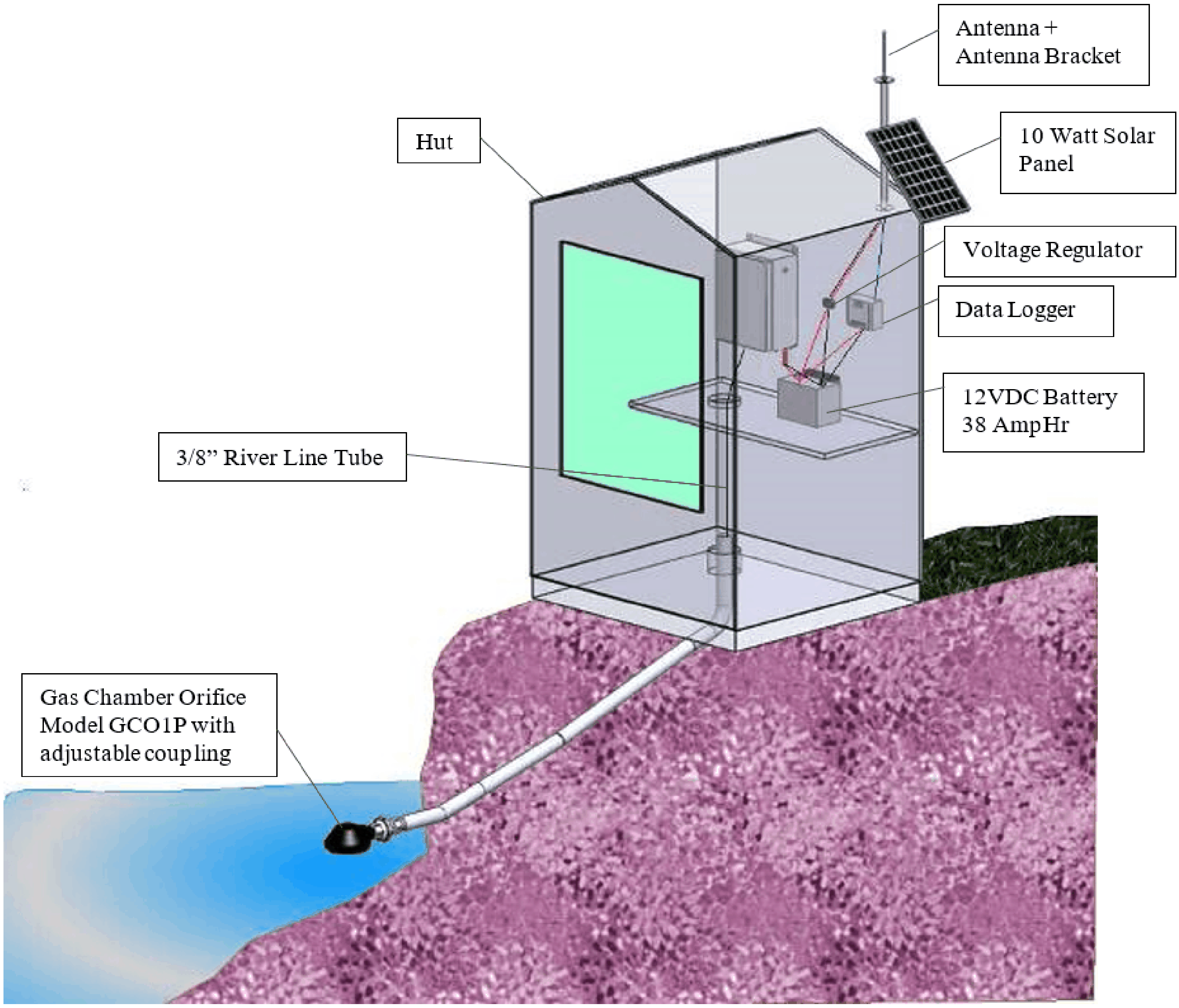
Ensure that the GCO1 is horizontally level as shown. Flexible coupling allows adjustment up to 30 degrees.



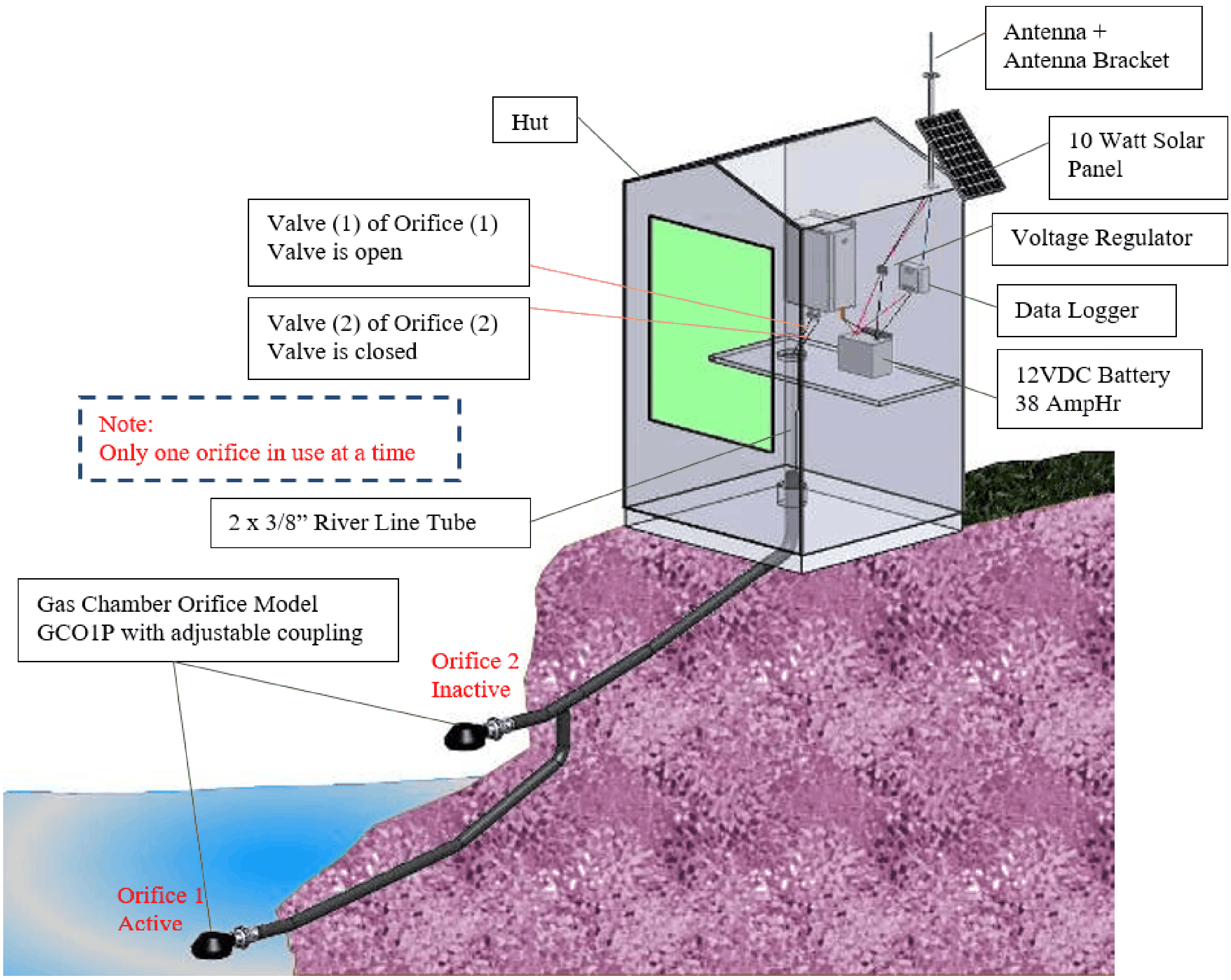
GCO1 DIMENSIONS		
Dimension	**Metric (mm)**	**Imperial (inch)**
L	410	16.2
D	210	8.3
H	110	4.3

9.4 Appendix D Typical Installations

Typical installation for HS40 Series II & HS40 Series II-DO (Dual Orifice)



HS40 Series II Typical Installation



HS40 Series II-DO Typical Installation

9.5 Appendix E Compressor Controller Bypass

The Compressor Controller provides the following features :

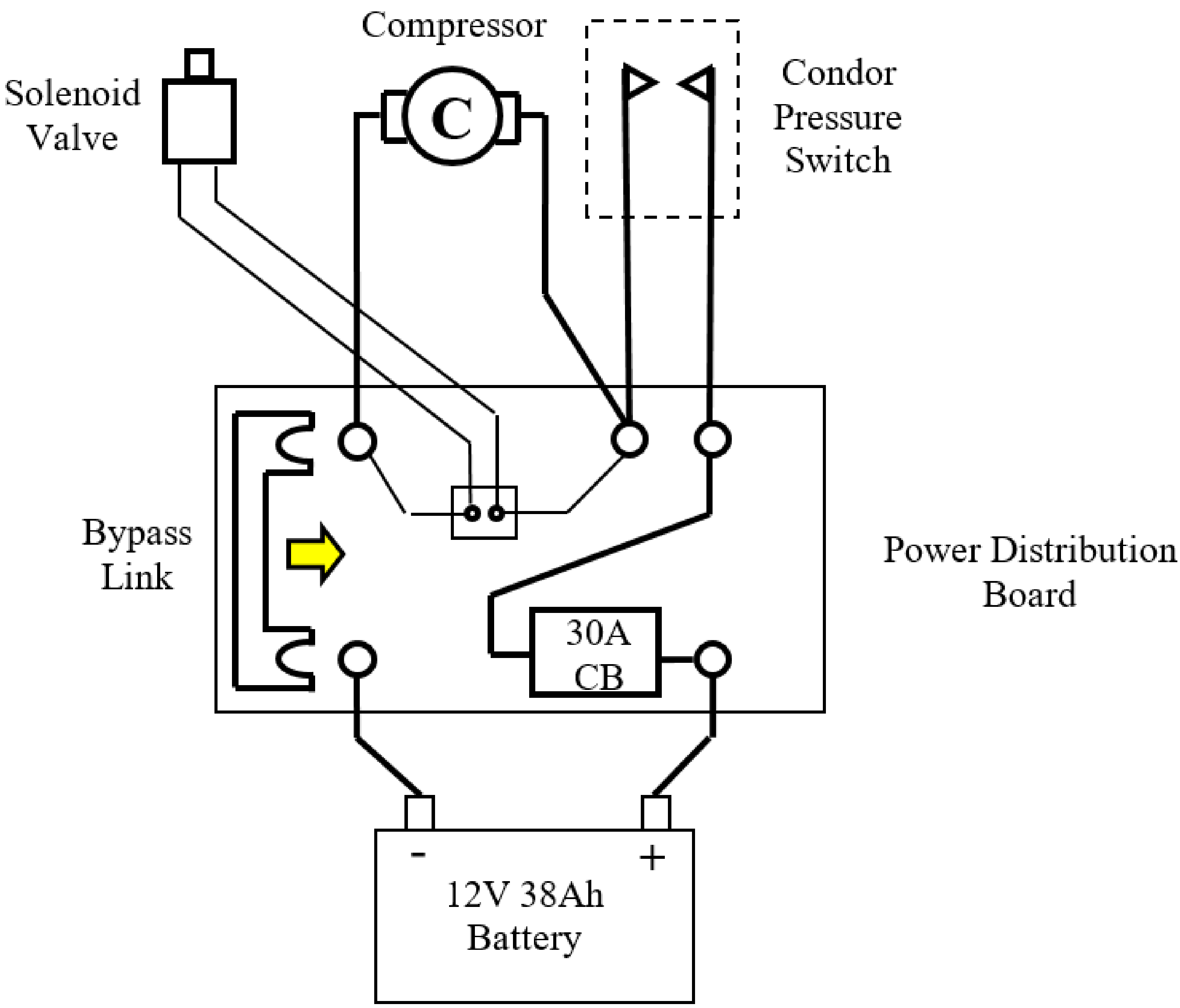
- Compressor soft start – to reduce peak battery currents.
- Battery voltage monitoring.
- Battery recovery after a low voltage.
- Battery low voltage and high voltage cutout – to protect the compressor.
- Compressor duration check – to prevent a flat battery if there is a pressure leak.
- Compressor duty cycle check – to protect the compressor from over heating.
- LED indicator of the system status.
- "Alarm status" digital output to a data logger or RTU.
- "Compressor operating" digital output to a data logger or RTU.
- SDI-12 interface to provide diagnostic information such as : system status, duration of the last pump up cycle, time since the last pump up cycle, number of pump up cycles in the last 24 hours, min battery voltage during the last pump up cycle, maximum current during the last pump up cycle, present battery voltage.

If a problem with the Compressor Controller develops, it can be removed from the system, and a bypass link inserted to keep the system operational while the controller is returned for repair. This means ALL of the above features are lost – but the HS40 Series II system will continue to be operational.

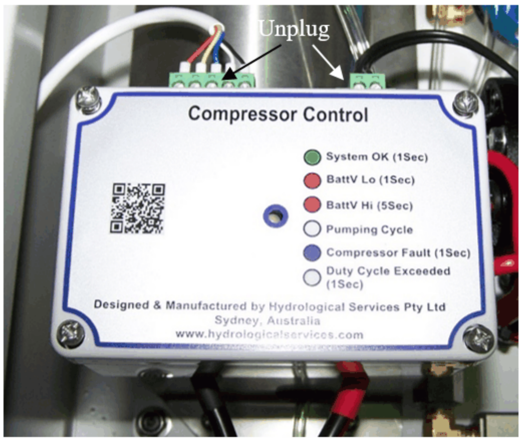
Important:

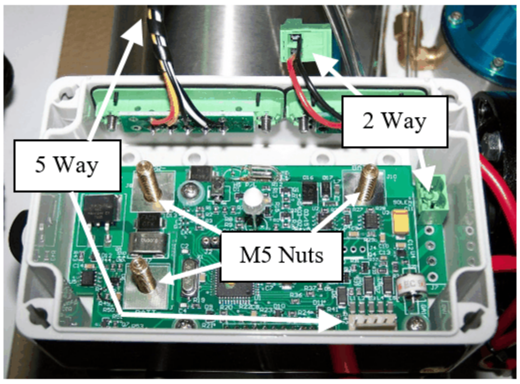
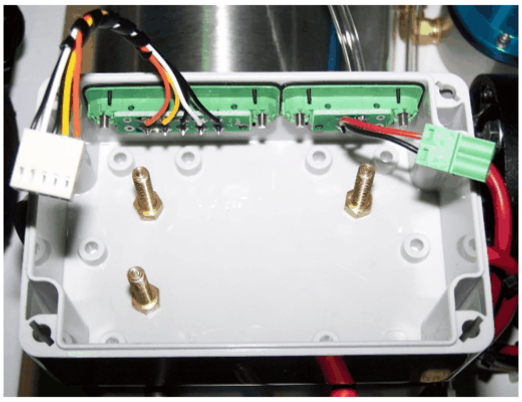
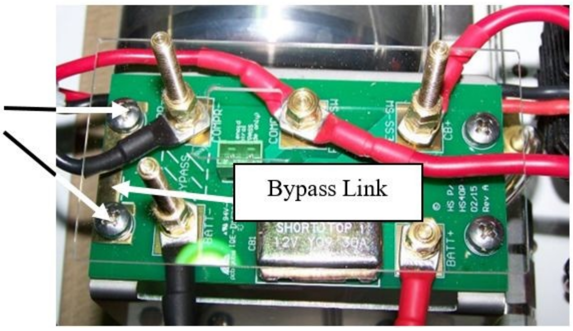
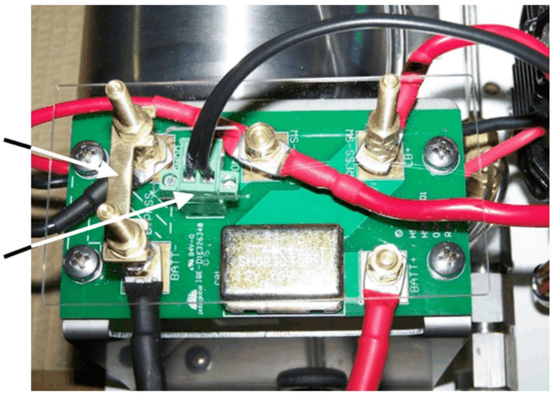
The HS40 Series II bypass mode should only be used in the event of a controller failure and the repaired controller should be replaced as

The following schematic shows the power wiring in the HS40 Series II – and how it has been designed for the "Bypass" link to keep the sy



To setup "Bypass Mode":

▪ Remove 12 V Power from the HS40 Series II – the bubbler will remain operational if there is air still in the tank. ▪ Undo the 4 x ¼ turn screws securing the lid of the Compressor Controller and remove the lid. ▪ Unplug the 5 way and 2 way screw terminal blocks from the controller. (Don't remove the wires, just unplug the terminals.)	

▪ Unplug the 5 way connector and 2 way connector from the PCB ▪ Undo the 3 x M5 nuts (with an 8 mm spanner or socket) and remove the Compressor Controller PCB.	
▪ Undo the remaining 3 x M5 nuts and remove the enclosure.	
▪ Loosen the 2 x Phillips head securing bolts and remove the brass "bypass link". ▪ Retighten the 2 x Phillips head bolts.	
▪ Place the brass "bypass link" across the 2 brass bolts and secure with the M5 brass nuts as shown. ▪ Plug the 2 way screw terminal (solenoid valve) into the connector as shown.	

Reconnect the 12 V battery, and the HS40 Series II will be fully operational, excluding the Compressor Controller features listed previously.

Before leaving the site, check the system is fully operational by manually purging the system so the pressure falls below 400 kPa, ensure the compressor recharges the tank and then purges moisture from the system - as it normally would.

Important:

The HS40 Series II bypass mode should only be used in the event of a controller failure and the repaired controller should be replaced as soon as possible.

Reinstalling the Compressor Controller Board requires the above steps to be reversed.

Contact Data

Europe	| KISTERS Europe	|	+49 2408 9385 0
		|	hydromet.sales@kisters.eu
		|	www.kisters.eu
Australia	| KISTERS Australia	|	+612 9601 2022
		|	sales@kisters.com.au
		|	www.kisters.com.au
New Zealand	| KISTERS New Zealand	|	+64 7 857 0810
		|	sales@kisters.co.nz
		|	www.kisters.co.nz
Latin America	| KISTERS Latin America	|	+57 350 575 4079
		|	sales@kisters-latam.com
		|	www.kisters-latam.com
North America	| KISTERS North America	|	+1 561 459 4876
		|	kna@kisters.net
		|	www.kisters.net
Spain	| KISTERS Ibérica	|	info@kisters.es
		|	www.kisters.es
France	| KISTERS France	|	+33 1 4120 9200
		|	info@kisters.fr
		|	www.kisters.fr
Canada	| KISTERS Canada	|	kna@kisters.net
		|	www.kisters.net