# Hydrosteel 6000 User Manual V1.8



Advanced Gas Sensing Technologies

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# Declaration of conformity

**Manufacturer:** Ion Science Ltd, The Way, Fowlmere, Cambridge, England. SG8 7UJ

**Product:** Hydrosteel 6000

**Product description:** the ultimate portable monitoring tool for sour, HF and high temperature corrosion and diffusible hydrogen damage in steel. The intrinsically safe instrument is totally non-intrusive and with minimal test surface preparation, and no consumables such as grease required, reliable measurements can be made within a minute.

**Marking:** Ex II 2 G Baseefa02ATEX0093 EEx ia IIC T4 $-20°C \leq Ta \leq +60°C$

**Notified body:** ATEX: Baseefa 2001 Ltd, Rockhead Business Park, Staden Lane, Buxton, Derbyshire, SK17 9RZ

**Notified body No:** EC 1180

| | | |
|---|---|---|
| **Directives:** | 94/9/EC | ATEX 100A |
| | 89/336/EC | EMC |

| | | |
|---|---|---|
| **Standards:** | BS EN 13908:2002 | ATEX – Application of quality systems |
| | BS EN 50014:1998 | ATEX - general requirements |
| | BS EN 50020:2002 | ATEX – Intrinsic safety "i" |
| | BS EN 61010-1:2001 | Safety requirements for measurement, control & lab equipment use |
| | BS EN ISO 9001:2000 | Quality management systems |
| | BS EN 61326-1:1997 | EMC – Equipment for measurement, control and laboratory |

I the undersigned herby declare that the equipment specified above conforms to the stated Directives and Standards.

**Signed By:**

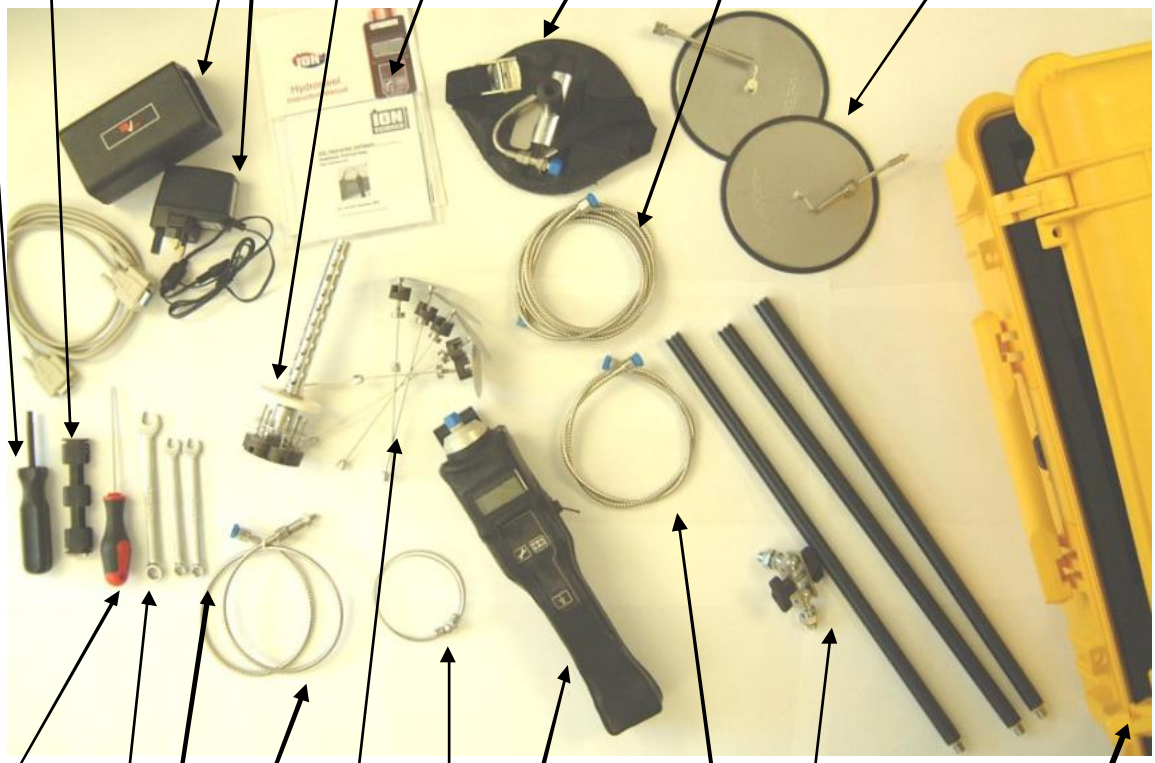
Name: Mark Stockdale,
Position: Technical Director
Date: 23rd April 2007

**Safety:** This intrinsic safety rating permits its deployment in all potentially explosive atmospheres of the quoted (or less demanding) rating. That is, in areas where explosive gases (of Group IIA, IIB and IIC) are intermittently present (Zone 1), within an ambient temperature range of -20°C and +60°C.

Hydrosteel complies with the requirements of 73/23 EEC low voltage directive and, apart from a low voltage pump, there are no moving parts within the instrument so that the machinery directives are not applicable.

# CONTENTS

# Contents of the Hydrosteel 6000 Complete Kit



# 1 - About Hydrosteel 6000

## 1.1 Principle of Operation

**Collecting a hydrogen sample**
Hydrosteel 6000 enables measurements to be made of gaseous hydrogen flux emanating from a steel surface. The steel surface can be of variable curvature and surface condition.

To make the measurement, a stream of ambient air is drawn across the steel surface by a high performance low-power-demand pump. This test-gas stream is confined within a specially designed 'collector plate' contained in the probe assembly which is attached to the steel surface. The probe assembly and collector plates vary according to application. The probe types are listed with there features in **Section 1.2**.

The collected hydrogen is conveyed through narrow bore tubing, into the measurement analyser, and across the face of a very sensitive amperometric detector.

**Determining the level of the collected hydrogen**
The zero hydrogen datum point for Hydrosteel 6000 measurement is the background hydrogen concentration in air at sea level, namely 0.5 ppm[1]. Rapid diffusion, and hence rapid dispersion of hydrogen in air, results in a very low and stable background prevailing in the ambient air of most environments, even indoors. This condition enables the Hydrosteel 6000 to be used in measuring a very small flux of hydrogen emanating from steel as a result of its interaction with hydrogen occluders and hydrogen occluding processes. The integrity of the measured data is circumscribed by drift in the ambient air hydrogen content, and this drift is usually very low.

The flow of the test-gas stream F across the steel surface is carefully regulated by means of restrictions, and a flow bypass, between the pump and the detector to ensure that it remains smooth and constant. An additional feature of the flow bypass is to ensure that in the event of a probe blockage, the pump is not working against a negative pressure differential. Flow regulation is particularly important as the flux J of hydrogen emanating from the steel is given by:
$J = c \times F / A$

where A is the effective area over which hydrogen is captured, and c the enhanced hydrogen concentration resulting from hydrogen entrainment.

# 1 - About Hydrosteel 6000

Output from the amperometric sensor is an electric current, which is proportional to the concentration of hydrogen presented to it. This current is amplified and scaled for display, and logging, as a hydrogen flux.

To summarise, the prowess of Hydrosteel 6000 technology stems from capturing the hydrogen flux from a well defined area of steel surface in aknown flow of air, and measuring the very small enhancement in hydrogen concentration entrained in the air stream. By this means, the very small hydrogen flux commonly emanating from steel can be quantitatively measured, easily, rapidly and reliably.

## 1.2 Application specific measurements

Hydrosteel can be used to locate, map, and monitor hydrogen flux as detailed in **Section 1.3** below. Hydrosteel engages interchangeable probes to enable attachment to steel of diameter greater than2 in., 5 cm, and surfacetemperatures from -40 to +500°C, -40 to 930°F. The interchangeable probes are classified as follows:

**LT-R: Low Temperature – Roaming Probe**

This probe utilises a collector plate 6 in., 15 cm across to deliver the maximum sensitivity, and is magneticdly attached to steel of 3.5 in., 9 cm diameter or greater, of surface temperatures up to 130 °C, 265 °F for short periods (quick spot measurements only), and 110°C, 230 °F for general use (for extended periods please consider use of AT-S probe). To ensure efficient hydrogen capture in wet or windy conditions, the LT-R probe incorporates a flexible seal around its perimeter.

**HT-R: High Temperature – Roaming Probe**

This utilises a small collector plate to give the instrument the maximum dynamic range commonly required with hot steel for which hydrogen permeation is enhanced. The roaming probe is magnetically attachable to steel of at least 8 in., 20 cm diameter, and has an operating temperature range extending to 500°C, 930 °F. The probe is sufficiently smdl to access steel through standard inspection ports

**AT-S: All Temperature – Stationary Probe**

This probe is 6 inches in diameter and designed to be semi-permanently attached to a steel surface, down to 2 inches in diameter, for frequent monitoring at thesame site. The probe can be attached to steel at temperatures up to 500°C, 930 °F.

**HT-S: High Temperature – Stationary Probe**

This small collector is designed for semi-permanent attachment to pipe bends and other curved areas, where corrosion can be significant, and steel pipes with a diameter as small as1.5 in., 4 cm, at temperatures up to 500°C, 930 °F.

Notes: When changing probe you should re-programme the instrument during start-up, as described in **Section 2.2**. Maintenance and replacement of the probes is described in **Section 5.3**.

# 1 - About Hydrosteel 6000

## 1.3 Deployment Methods

Hydrosteel 6000 can be deployed to meet several different objectives as described below.

**Hydrogen flux search**

The Hydrosteel analyser has a real time display offlux which can be used to search for sites of hydrogen permeation. Since the analyser commences measurement at the time of attachment to a surface, and a 50% response is achieved in approximately 20 seconds, prospective hydrogen permeation at a given sitecan be established within this time. An extension arm can be used to deploy the collector to a surface some 6 ft (2 m) beyond normal reach.

**Spot measurements**

Once a site of interest has been located, the hydrogen flux can be measured within a period of one minute. It may be convenient to log the measurement using the handheld Hydrosteel 'short log' facility. Whilst waiting for the measurements to be logged, the handheld analyser can be attached to the steel pipe under test using its magnetic leather case. This procedure allows you to make notes or demarcate the site for re-testing in the future.

**Continuous monitoring**

A site can be monitored for up to the lifetime of the batteries using the Hydrosteel 'long log' facility (see **Section 4.1**). Logging can be extended indefinitely using external power (see**Section 2.5**).

**Zone Programming**

When performing the above measurements data can be logged with respect zone or area of test. Available to the user are 199 zones that act as memory tags for saved logs. Each zone can be named with a 64-character header. (see**Section 4.3**)

## 1.4 Calibration Check Facility

Hydrosteel is calibrated in-house, but the equipment is offered with a function test facility to enable you to check that your equipment is performing within specification. Please refer to **Section 5.1** for the check procedure.

# 2 - Using Hydrosteel 6000

## 2.1 Initial Appraisal

A number of accessories accompany the Hydrosteel 6000 Analysis Kit. When you first receive your Analysis Kit, we suggest that youcheck the items received against the Packing List. If any item is damaged or missing, notify your supplier, stating the serial number stamped on the rear of the handheld analyser, together with your order number and the supplier's invoice number. Familiarise yourself with the components of the Hydrosteel 6000 Analysis Kit (pages 3-4).

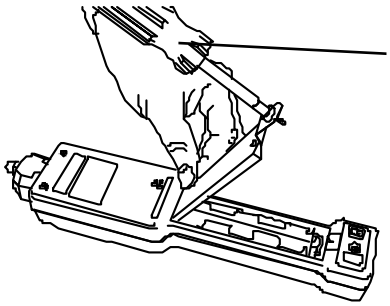
## 2.2 System Assembly and Start-up

**Normalising the analyser**

1. Remove the analyser from the field case.
2. Remove the leather outer case.
3. Using the special key provided, open the battery compartment (at the rear of the analyser) and insert the four batteries complete with their holder (supplied) – see the diagram below.

   Close and lock the battery compartment.
4. Refit the leather outer case. Press the on/off key (**I/O**), which is located on the analyser front panel.

> WARNING
>
> The analyser batteries must be alkaline-type AA-size. Using any other type of battery will invalidate the Intrinsic Safety approval.




5. A countdown shows the time remaining, and a red LED flashes. The detector is then normalised, and a hydrogen flux measurement of (default units of pl/cm$^2$/s) is displayed.

## 2 - Using Hydrosteel 6000

6 Your Hydrosteel 6000 analyser is now operational.

7 When not required for immediate use, switch off the analyserby pressing the on/off key (**I/O**). The analyser takes a few seconds to shut down, during which time you can abort the switch-off by again pressing the **I/O** key.

**Connecting the low temperature (LT-R) probe to the analyser**

1 Attach one end of either the 70 cm or 200 cm gas sample tubes to the connector at the top of the analyser as shown below. Tighten finger tightNote: we recommend that you use the shorter of the two sample tubes. However, if you require the extension arms, you may find it necessary to use the longer (200cm) sample tube.

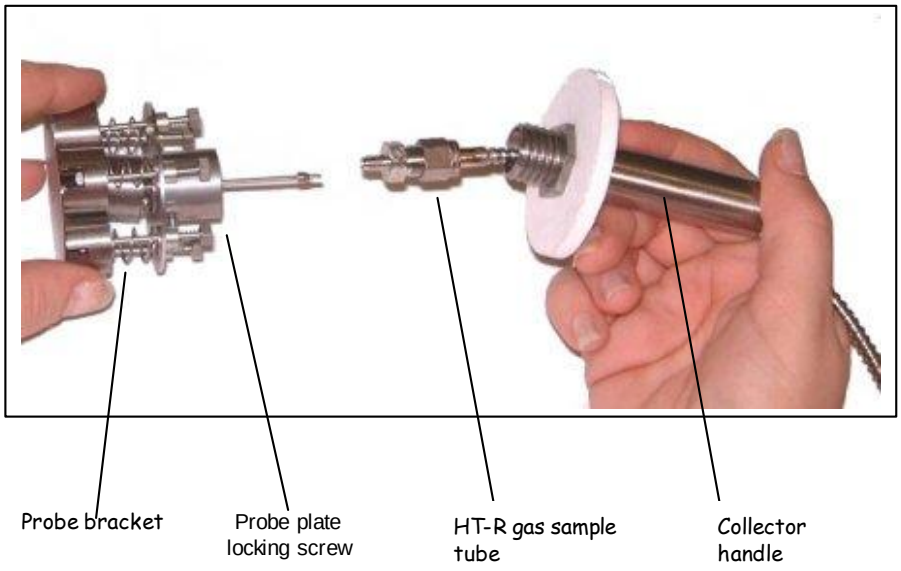
2 Attach the other end of the sample tube to the LT-R probe. Tighten finger tight.

3 If required for extended use, attach one or both of the extension arms to collector assembly, as on the next page.

# 2 - Using Hydrosteel 6000

## Connecting the high temperature roaming (HT-R) probe to the analyser using HT-R flexible conduit

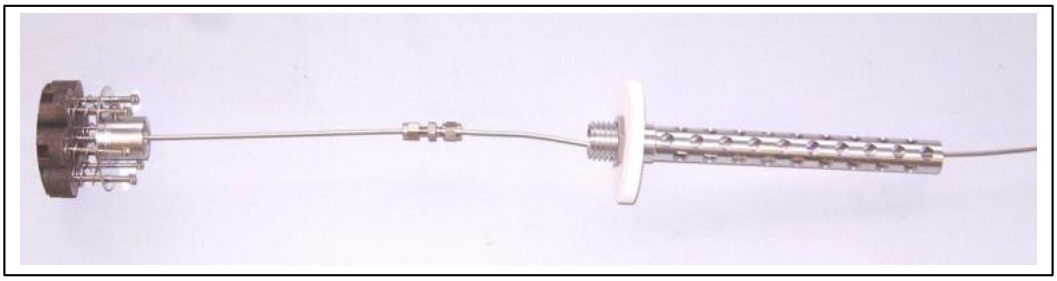
1 Remove HT-R collector assembly from the box and remove the magnet sleepers.
2 Manually unscrew the collector handle from the assembly. (The handle unscrews below the white heat shield).
3 Insert the HT-R 2ft flexible conduit assembly (A-41019) through the handle as shown below. Tighten the nut onto the collector plate until it is finger tight. Screw into place the HT-R handle.



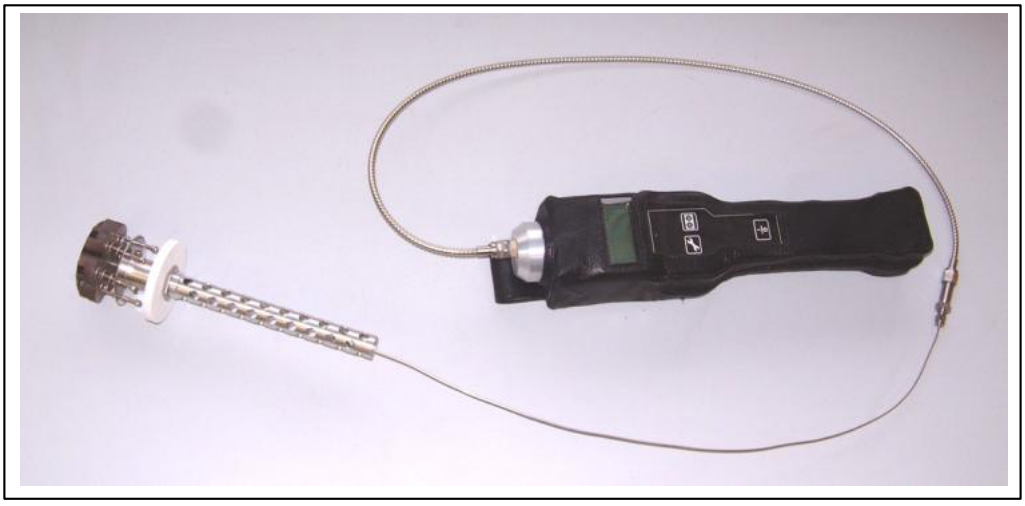
## 2 - Using Hydrosteel 6000

**Connecting the High Temperature roaming (HT-R) probe to the analyser using HT-R very HT extension conduit.**

1 Remove HT-R collector assembly from the box and remove the magnet sleepers.
2 Manually unscrew the collector handle from the assembly. (The handle unscrews below the white heat shield).
3 Insert the HT-R very HT extension conduit assembly(A-41017) through the handle as shown below. Tighten the nut onto the collector plate until it is finger tight. Screw into place the HT-R handle.



4 The HT-R very HT extension conduit assembly is connected to the analyser using the HT-R 2ft flexible conduit assembly (A-41019) as shown below.



# 2 - Using Hydrosteel 6000

Before proceeding further, ensure that you are familiar with the **user recommendations** and the **analyser menu structure** described below.

**User recommendations**

Hydrosteel 6000 is a robust unit with electrical and pneumatic design features to ensure that accidental misuse does not represent a threat to the user or to the sensitive system components. However, we recommend that you:

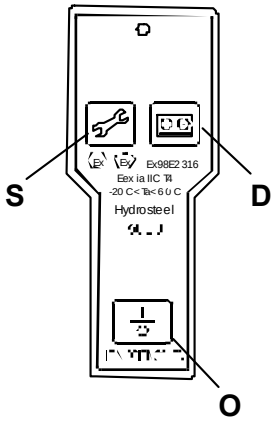
* consult this manual or the service team at Ion Science when you are unsure of how to proceed.
* avoid exposing any part of the system to corrosive media or liquids.
* avoid exposing the system components to ambient temperatures that exceed 50 °C for more than a few hours.
* when not in use, store all the system components and equipment in a cool dry place.

## 2.3 Analyser Operation Menu

**Three front-panel keys**

On the analyser front panel, the three keys

**S** (**S**panner),
**D** (**D**ata) and
**O** (**O**n/Off)




have dual functions, according to whether the analyser is in:
'start-up mode', for 90 s normalisation after the analyser is switched on, or...
'operating mode', after normalisation.

| Key | Start-up mode | Operating mode |
|---|---|---|
| **S** | adjust time, flux units, probe, temperature scale | select zone, check calibration |
| **D** | handle data log | log data |
| **O** | turn off / zero | turn off / zero |

# 2 - Using Hydrosteel 6000

The key options available are shown on the analyser display. After completing a function, the analyser returns to start-up mode or operating mode, as appropriate. For example, in start-up mode, you can divert to reset the clock because of a change to Summer Time and, on completion of this function, the analyser automatically completes the normalising procedure.

For reference, a complete list of the key sequences, together with countdowns and available interrupt keys is provided in **Appendix B**.

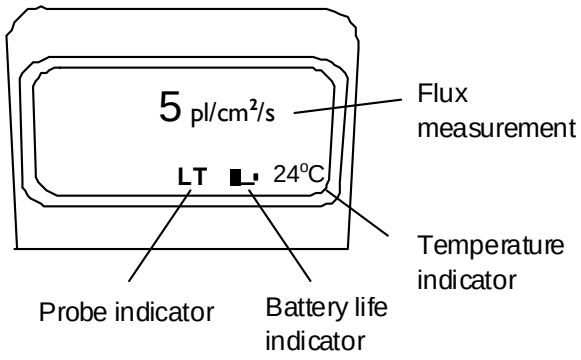
## 2.4 Analyser display

As part of the start-up procedure, the analyser sequentially displays the instrument name, manufacturer, data log details and calibration details. Thereafter a countdown is displayed until normalisation of the analyser is complete. **Note:** If the analyser has been used recently, the normalisation countdown can be reduced by pressing the **O** key twice.

After normalisation, three measurements are displayed, as described below.

**Hydrogen flux**

In normal operating mode the analyser display indicates measured hydrogen flux, or flow per unit area, collected from a surface, in units of 'pl/cm²/s' or 'nm/s'.




The flux units are corrected for standard temperature and pressure. That is, 1 pl/cm²/s = $10^{-12}$ litres of hydrogen at a pressure of one atmosphere, (760 mm Hg, 1014 mbar), and 20°C, emanating from each square centimetre of surface per second. Flux measurements exceeding 1000 pl/cm²/s are displayed in units of nl/cm²/s to two decimal places (1000 pl/cm²/s = 1 nl/cm²/s).

## 2 - Using Hydrosteel 6000

When the collector is not attached to a steel surface, a flux continues to be displayed in order to give a clear indication of any background drift, which may affect the integrity of subsequent measurements.

**Battery level indication**

At the base of the display a battery icon is indicated together with the temperature in degrees Centigrade. As the battery becomes exhausted the battery icon progressively empties, until the icon is shown in outline only and, subsequently, it flashes.

When the battery symbol is flashing, data logging may not be possible and, although the system is still functional, quantitative measurements of hydrogen flux are not recommended.

**Temperature indication**

Located at the bottom right of the display, the indicated temperature measurement is one taken from inside the analyser, near the hydrogen sensor. During temperature changes, the displayed measurement flashes, indicating that you can expect some temporary background signal drift as the detector re-adjusts to the change in temperature. If you are experiencing temperature changes to the unit during operation it is highly recommended that you use the thermally insulating leather jacket.

**Probe indication**

To the left of the battery icon the display one of the following, denoting the probe in use. Ensure at all times that the probe in use and probe indicator correspond. If not, reconfigure the analyser to indicate the correct probe from the analyser start up menu, as indicated in **Appendix B**. The probe indicator should correspond to the probe in use as follows:

| | |
|---|---|
| **LT** | **LT-R (low temperature roaming)** |
| **HT** | **HT-R (high temperature roaming)** |
| **(blank)** | **ambient hydrogen measurement (probe independent)** |

# 2 - Using Hydrosteel 6000

## 2.5 Using an External Power Supply

To extend the continuous operation time of the analyser, particularly for long term monitoring applications, an external power supply can be used.

For satisfactory operation, the analyser requires a 6 V dc regulated power supply, capable of delivering 200 mA minimum.

**Note:** It is important to ensure that the centre pin of the connector is positive with respect to the shroud. Failure to provide this connection may cause damageto the analyser circuitry.

**WARNING**
**If the Hydrosteel analyser is to be used in an intrinsically safe zone, any external power supply must have appropriate safety certification.**

# 3 - Guide to field measurements

**Step 1: Preparing the equipment for flux measurements.**
Open the field case. Connect the hand held analyser to either the 6" diameter LT probe in the field case or the HT probe in the HT-probe kit box, using the appropriate gas sampling tube. This comprises essential test equipment, it weighs 1 kg, and can be conveniently carried in a shoulder bag or small rucksack. Before commencing a prolonged series of spot measurements, or extended monitoring at one particular site, ensure sufficient battery power is indicated by a full battery indicator on the analyser display. If necessary replace batteries using the battery tray key.

**Step 2: Confirming suitability of ambient conditions.** Turn on the analyser (I/O key) in the open air at least 10 m from any source of hydrogen. If you are using a different probe than previously, reconfigure the analyser during the normalisation countdown (see **Appendix B** for menu) to indicate the correct probe (LT - low temperature or HT – high temperature). The analyser's internal temperature will be indicated on the display panel. A flashing reading indicates that the analyser is experiencing an abrupt change in temperature, in which case allow several minutes for the flashing to subside. It is highly recommended to use the thermally insulating leather jacket to reduce the effect of abrupt temperature changes. Abrupt temperature changes may occur for many reasons. Most common are moving from a heated or air conditioned environment to the cold or hot local conditions. Alternatively the radiant heat from hot pipes or equipment may create a significant temperature change. When approaching hot pipes use the 2 meter high temperature sample tube (in addition to the thermal jacket) this will allow the analyser to be shielded and kept at a greater distance from the hot test area. Connect the appropriate probe.

After the countdown the analyser will display a reading of less than 5 pl/cm²/s with the LT probe and 0.03 nl/cm²/s with the HT probe.
Approach the test site location of interest. The only gas liable to compromise dependable measurement of hydrogen flux is hydrogen itself, for example within a few metres of hydrogen leaking from a flange. This will be registered on the analyser display and in the analyser's memory, enabling confidence in the logged measurements to be calculated when data is downloaded to a PC.

**Step 3: Steel test surface site selection and preparation.**
With the LT-R (6 inch diameter low temperature) probe:
7 inch diameter test surface sites should be identified on mild steel vessels or piping of 3.5 inches diameter or greater, and of surface temperature of less than 150°C, 300 °F. Locate sites which are smooth, particularly avoiding ridges or grooves.

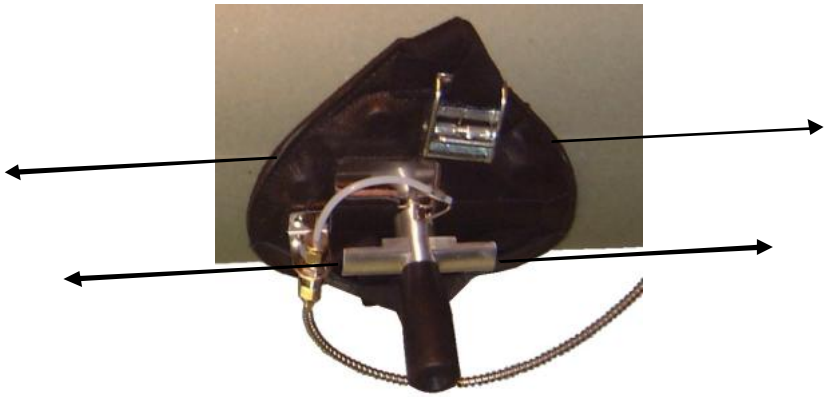
# 3 - Guide to field measurements

Remove dust, loose rust and liquids and disbonded paint work from the site. Disbonded paint is usually evident from flaky or cracked paint in the locale of the target site, and should be completelyremoved.

With the HT-R (2.3 inch diameter high temperature) probe:
3 inch diameter test sites should be identified on carbon or low alloy steel vessels or piping of 8 inches diameter or greater, and of surface temperature of less than 500 °C, 930 °F. For tests through inspection ports, ensure that there is a clear pathway through the port to the steel surface, so that when the probe is inserted, it engages fully with a 3 inch diameter surface of steel, without the intervention of insulation wool. Ensure that the test surface is completely free of any layers of rust.

**Step 4: Data handling.** If required, access the test site zone menu and data logging menu by pressing the keypad **Data** key (see **Section 3.1**).

**Step 5: Deployment procedure.**
With the LT-R (6 inch diameter low temperature) probe:
Ensure the probe plate underside is not damaged and is free from dust or magnetic detritus. Manipulate the probe by using the probe handle or extension arms. Introduce it directly to the test site, ensuring that the probe 'ALIGNMENT



indicator runs in the same direction as the pipe or axis of the vessel, as illustrated. Confirm the probe's flexible plate conforms snugly to the steel surface. On piping of less than 8 inches diameter, use the strap provided. The strap should be drawn tight as shown below, so as to ensure the probe plate is tight against the steel, when the hands are released.

## 3 - Guide to field measurements

With the HT-R (2.3 inch diameter high temperature) probe:
Introduce the probe directly to the steel surface. Any orientation of the probe is acceptable, but take particular care with piping of less than 12 inches diameter to ensure the probe's flexible plate is attached snugly to the metal surface. Note: the high temperature magnets are attracted to steel less strongly than conventional magnets: be particularly careful during measurements not to pull away the probe from the steel.

**Step 6: During measurement and monitoring** The analyser - in its jacket - can also be secured magnetically to any steel nearby at ambient temperature. A significant response should be evident within 20-25 s of probe engagement, and flux measurement obtained within one minute. For spot measurements, allow 'remove probe' to appear on the display before removing the probe. Extended monitoring is terminated automatically on loss of sufficient battery power, or by operator intervention (RECORD key). Demarcate the site as required during the test measurement.

**Step 7: Completing the task.** To download data to computer, remove the analyser from the jacket, activate 'PC connect (TOOL-RECORD keys), align with the IRDA link box, and execute the file ISPLC.EXE. (See **Section 3.2**). Make sure test equipment is clean and dry, return to the field case, and store field case in a cool dry location.

WARNING

**The HT-R probe and associated equipment includes a heat shield which partially reduces the temperature of the collector handle. It does NOT enable handling of the collector without gloves. ALWAYS wear suitable heat resistant gloves when handling the high temperature collector**

# 4 - Data logging and computer interface

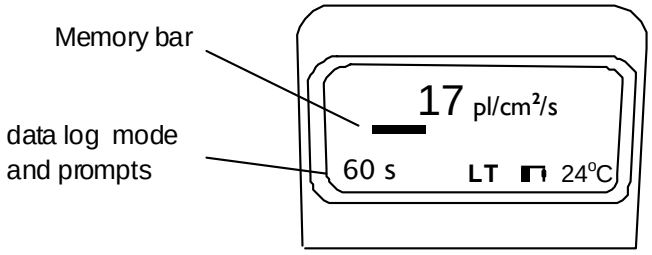
## 4.1 Using the Data logging Facility

Two data logging modes are available– 'short' and 'long'.

'Short' data logging stores measurements over a one minute interval and is used for obtaining a spot flux measurement at a specific site. In this mode, a record is obtained, not only of the analyser response, but also of recent measurement stability. When the data is downloaded to computer the response of the analyser due to attachment of the device is computed and displayed as a measurement together with the measurement uncertainty due to any background hydrogen drift.

During 'long' data logging, measurements are first recorded every five seconds then at a reducing rate until stopped manually, or by an analyser feature (memory overflow or battery empty).

During both forms of data logging, the data memory used is indicated by a memory bar extending across the display from left to right. This memory bar blinks on each occasion that data is recorded. Appropriate log prompts are indicated at the bottom of the display.




**Short data logging**

1. From normal operating mode, access 'short' data logging by pressing the **D** (data) key twice. While **attach probe** is displayed, attach the probe to the target steel surface.
   The memory bar flashes at one-second intervals.
2. Twelve 5-second time-averaged measurements are recorded, together with the date/time stamp, analyser temperature, selected probe, and zone number and description.
3. When 'short' data logging is complete, **remove probe** will be displayed. Remove the probe from the steel surface. The analyser reverts to normal operating mode automatically.

# 4 - Data logging and computer interface

**Making a single measurement**

In order to make a single measurement, 'short' data logging can be abbreviated, as follows:

1. As above, from normal operating mode press the **D** key twice to enter 'short' data logging.
2. As soon as the memory bar appears (which signifies that one flux measurement has been recorded) press the **D** key.
   while the prompt **to end log** is displayed, press the **D** key again twice.

**Long data logging**

1. As above, from normal operating mode, access 'short' data logging by two **D** key presses.
2. Wait for the memory bar to be displayed.
3. Press the **D** key again once.
   The prompt **to end log** is displayed and 'long' data logging has started.
4. Measurements are automatically recorded:
   at five-second intervals for the first 10 minutes,
   at one minute intervals for the next 120 minutes,
   then every 10 minutes.
   During each 10-minute period of 'long' data logging, the analyser enters a sleep cycle, during which analyser functions such as the measurement circuitry, including the pump, are only active for about 90 s. During the sleep cycle, the prompt **sleeping** is displayed for the remainder of the 10 minute period.
5. To exit data logging from 'sleep' mode, press the **D** key slowly, twice.

## 4.2 Communication between analyser and PC

Communication between the analyser and computer requires the use of the IR Link Box, Hydrosteel software and Windows PC connect software ISLPC.EXE. The IR Link Box is provided with your Hydrosteel 6000 Analysis Kit as is the ISLPC software on floppy disk.

Communication between the instrument and a PC allows the following functions to be performed.

- Downloading of logged data from the instrument to the PC for storage and analysis.
- Erasing logged data.

# 4 - Data logging and computer interface

- Downloading or updating zone headers to instrument.
- Checking instrument details, eg, serial number, logged memory used.
- Displaying and recording flux measurements on PC in real time.
- Re-programming analyser with a firmware upgrade.

**Hardware requirements**

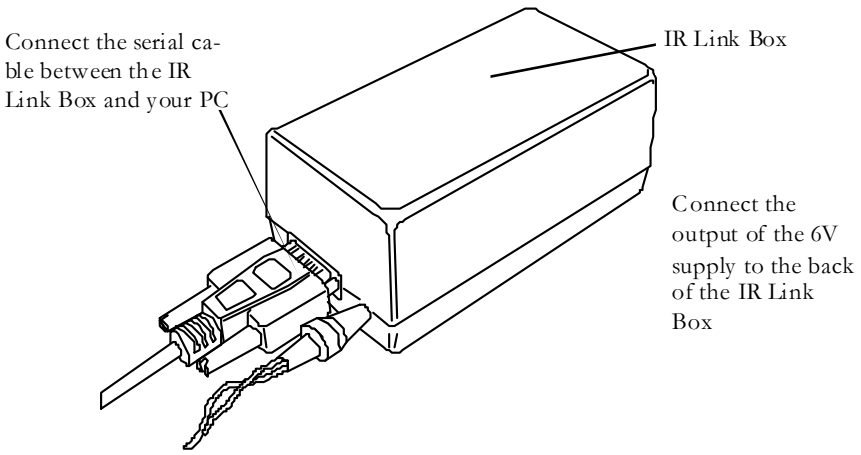
ISLPC data interface software runs on a PC under Window® 95 (or later), or NT, for the processing of saved data files.

Data downloading, interfacing and upgrading of an instrument requires the use of an IR link Box (supplied by ISL) connected to the RS232 communications port of a (user supplied) PC.

The IR Link Box works with serial communications to your PC, running at 19200 baud, 8-bit data, no parity and 1 stop bit.

**About the IR Link Box**

The IR Link Box enables serial communications to take place between the communications port on your PC and the IR port on the Hydrosteel analyser. Ensure that no other program on your PC is using the serial communications portwhen you want to transfer data from the Hydrosteel analyser.




**Connecting the IR Link Box**

1. Connect the 6 V dc power supply (provided) to an ac supply.
2. Connect the output of the 6 V dc power supply to the back of the IR Link Box. A red LED will blink regularly when the IR Link Box has power applied to it.
3. Connect the serial cable (provided) between the back of the IR Link Box and the serial connection on your PC.

**NB** A USB to Serial (RS232) adaptor may be used if your PC or laptop no longer has an RS232 port.

# 4 - Data logging and computer interface

## Installing the ISL data interface software

Copy the complete ISL directory (Ion Science Ltd) from the disk provided onto your computers C: drive.

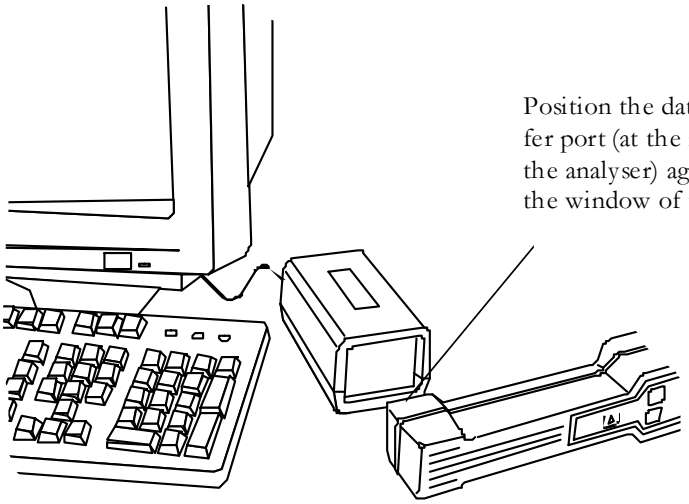
When using the software for the first time you will be required to select the appropriate communications (serial) port that your IR Link box is connected to. To select a port enter the ISLPC software program and click on the Settings tab.

## Downloading Data from your Hydrosteel

1. Remove the Hydrosteel analyser's leather jacket. Turn the analyser on. To enter normal operation either allow mode (90 s countdown) or press the on/off key twice to zero the instrument. Now press the Spanner, then the Data key. The instrument will display **PC connect**.

2. Locate the infrared port at the rear of the Hydrosteel and then position this port at about 5cm (2") away from the data-transfer window of the IR LINK Box, ensuring that the IR port is oriented downwards, ie, adjacent to the desk surface as shown below.

3. Ensure that no other program on your PC is using the serial communications (IR) port.



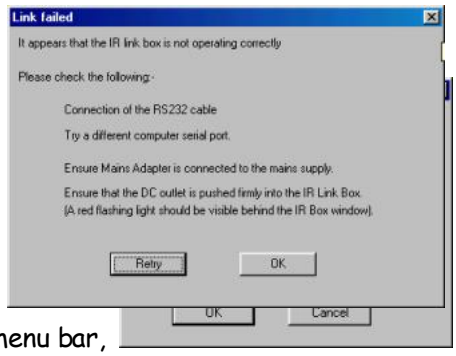
Position the data transfer port (at the rear of the analyser) against the window of the IR

# 4 - Data logging and computer interface

**4** Within the ISL Directory on your PC, doubleclick on the **islpc.exe** icon.

**5** If the message window 'Connected to Hydrosteel is displayed, Proceed to step **7**.

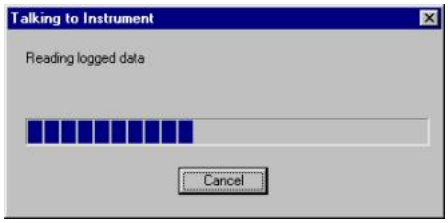
**6** If the 'Link Failed window is displayed, check the Hardware as instructed, using **Retry** as required.




To change the prescribed serial port, click on **OK**, select **Hydrosteel**, and from the 'ISL Instrument Interfacé window menu bar, select **Settings**, **Port**. Click on an alternative serial port (usually Com 1 or Com 2), click **ok**, and close the 'ISL instrument interface menú panel. Return to step **4**.

If problems persist, please contact the supplier or Ion Science Technical staff.

**7** The 'ISL Instrument Interfacé window is now displayed. From the menu bar, click on **Data, download**. During data transfers, an additional LED in the IR_Link box will flash occasionally. The progress in data downloading is displayed.




The Interface program will display other messages if there are problems. If the communication with the analyser fails, the message window shown in step **6** will be displayed.

# 4 - Data logging and computer interface

**Data download display**

Data files downloaded from an instrument are presented in three windows:

1/ Data file index, summary data is ordered sequentially according to zone, and then log file number. Spot (60 s) measurement log files include a 'computed flux', with an associated uncertainty, based on the response transient of the instrument and prevailing instrument drift (if any).
2/ Data file graphical analysis flux transients corresponding to each data file are displayed. See also Section **4**.
3/ Data file numerical data detailed data for each recorded data log.

The horizontal menu bar at the top of the 'ISL Data Interface' window provides access to the main features of the ISLPC Software. Depending on the displayed feature, abbreviated versions of these menus are available by right-clicking the mouse.

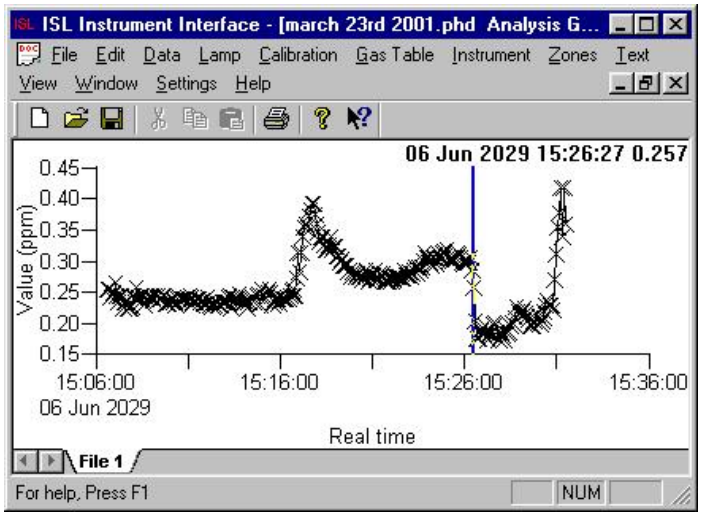
**Caution:** Before closing the programme, from the **Data** sub-menu, ensure you either **Save** data downloaded from the analyser, or **export** the data, for use in spreadsheets such as Microsoft Excel. More details on specific menu options are given below.

# 4 - Data logging and computer interface

## Graphical analysis of data

### Setting the time and response scales

Choose Elapsed/Real time as required for time scale.
Choose Spread/Zero reference and Log/Linear scale required for the recorded response.




Using the cursor Right Click on the graphical analysis window to reveal the dropdown menu with the following options:

- Elapsed/Real time
- No Markers
- Cursor on/off
- Log/Linear scale
- Spread/Zero reference
- Alarms on/off

Choose No Markers to remove all the crosses from the display.
Choose Cursor on and use mouse and a Left Click to position the cursor on the Graph. The data (x,y) will be shown top right.

# 4 - Data logging and computer interface

**Main ISLPC Menu Functions**

**File**

**Print**

Print highlighted (Numerical or Graphical) data file via your PC.

**Print Preview**

Allows you to view the currently chosen data file for next print.

**Print Set-up**

Allows the characteristics of the printer that is connected to your PC to be selected.

**Recent File**

Allows access to recently used files.

**Exit**

Exit the ISL Data Interface Software application.

**Data**

**Download Data**

Reads measurement data from the ISL instrument.

**Save, Save As**

Saves highlighted (Numerical and Graphical) data to PC file, in an encrypted format (*.phd). This is highly recommended to avoid having to download the same data again later, or to avoid losing data later on.

There are 2 levels of protection used to stop changes to records: the first level is data encryption and the second level is the watermark inserted by the islpc program into the encrypted data.

**Open**

Allows access to stored measurement data files. Refer to Section 4. The islpc program searches for the file validity before opening data, and VALID will then be inserted into the header data of an open file.

**Close**

Closed highlighted (Numerical or Graphical) window **Caution**: Before closing the programme, from the **Data** sub-menu, ensure you either **Save** data downloaded from the analyser, or **export** the data, for use in spreadsheets such as Microsoft Excel.

**Export**

Saves highlighted data as a comma separated variable file, *.csv file, for external analysis using standard spreadsheets, e.g. Excel. Please note *.csv files cannot be read by islpc.exe. The *.csv file contains a summary of all data files, followed by data presented in chronological order.

# 4 - Data logging and computer interface

## Instrument

### Download Data

Downloads measurement data from the ISL instrument. Provides the same facility as the Data menu.

### Erase All Data

Erases all data stored in the ISL instrument.

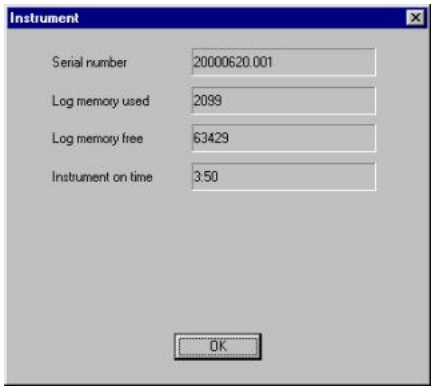
**Caution:** Ensure that any relevant data has been downloaded before using this option.

### Clear Zone Headers

Clears the zone headers stored inthe ISL instrument. As a consequence, all stored data is also erased- caution: ensure that any relevant data has been downloaded before using this option.

### Instrument Details

Reads details of the ISL instrument currently interrogated using the IR_Link. Serial Number, Log Memory Used, Log Memory Free and the Instrument On-time are specified.




### Show Reading

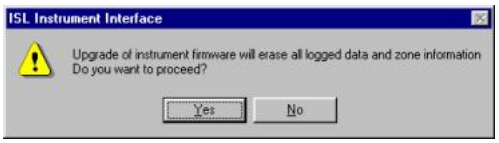
Enables a real-time display of the instrument measurement to be shown on your PC. Close this window to access any other.

### Diagnostics

Allows instrument data to be downloaded prior to hardware fault finding. Click on Read Flash, following instructions as they appear.

### Firmware Upgrade

Downloads an ION SCIENCE 'upgrade' file (*.upg) to the analyser. A complete upgrade consisting 4 files usually lasts about 4 minutes.




**Caution:** Ensure that all relevant data has been downloaded and saved to PC before using this option.

# 4 - Data logging and computer interface

**Zones**

**New**

Allows you to create a set of zone headings. Enter up to 60 characters into each of the 199 zone addresses. These can then be downloaded to Hydrosteel. Having created the headings, you can also save them as type (*.zon) files on your PC for future use.

**Open**

Provides access to an existing set of zone headings, which can be upgraded and/or downloaded to the analyser.

**View**

**Toolbar**

Normal Windows® feature.

**Status Bar**

Normal Windows® feature.

**Window**

**Window** provides the normal Windows® features, but is only available when data is displayed.

**Settings**

**Port**

Enables the correct PC port to be selected for the RS232 connection to the ISL instrument. Only used if the port used has been altered or for first time installation of the IR_Link & ISLPC.

**Help**

**Help Topics**

Refer to this manual until the ISL Help software file is available.

**About ISLPC**

Version reference details for the ISL Data Interface Software.

# 5 - Routine Maintenance

Only authorised and qualified persons must handle the Hydrosteel analyser, using all normal safety practices. Except for procedures described in this manual, the Hydrosteel analyser must be serviced by Ion Science, according to a prevailing contractual agreement.
Please feel free to ring our customer services department or e-mail us at service@ionscience.com if difficulties are encountered which have been inadequately covered by this manual.

## 5.1 Checking system performance

Normally, the HT-R and LT-R probe plates are only liable to damage and degradation after extensive use, when attached to a steel surface having ridges or high spots. Damage will be evident from worn or crushed grooves on the plate undersurface, and poor challenge test results. Replacement collector plates are supplied and should be fitted as indicated in **Section 5.3**.

All Hydrosteel equipment is factory calibrated. ION Science Ltd recommends the instrument and challenge kit be calibrated yearly. To be assured of analyser flow, pneumatic performance and hydrogen measurement are within specifications a function test using the Function Test Kit (Part No A-40107) unit is recommended. The function test does not re-calibrate the instrument.

The function test procedure is detailed over the following pages.

# 5 - Routine Maintenance

## Hydrosteel function test instructions

- To carry out the function test you must have the function test kit displayed above

The Hydrosteel function test is divided into two parts. The first is to check the sample flow. The second is to check the hydrogen sensor calibration.

### Flow test

The Hydrosteel flow is important to the accuracy of flux measurements. The function test uses a variable area flow meter to check the correct flow is being drawn into the instrument. The flow is determined by reading the tube markings from the middle of the float point. The readings should be between 40 and 55 for a unit that has a correct flow. The flow meter has to be on a level surface for correct operation.

1) Switch the Hydrosteel 6000 analyser on and let it complete the stabilisation count down and zero.
2) Ensure that the flow meter is on a level surface.

## 5 - Routine Maintenance

3) Connect short flexible sample tube from hydrosteel 6000 inlet to the top port on the flow meter.

4) Determine the flow by reading the tube markings from the middle of the float. The reading should be between 40 and 55 indicating that the instrument flow is correct.


5) If the reading is outside the limits stated above, retest the flow after checking that all connections have been made securely, and are leak free
6) If the unit is still reading outside the limits the unit will need to be returned to ISL for service and calibration.

**Sticking floats**. There is limited clearance between the float and the inside of the tube. In some cases flow tubes are found to 'stick' after transport or long periods in storage due to condensation resulting from temperature changes. It is advised to blow clean dry gas through the meter to free the float.

# 5 - Routine Maintenance

**Hydrogen gas test**

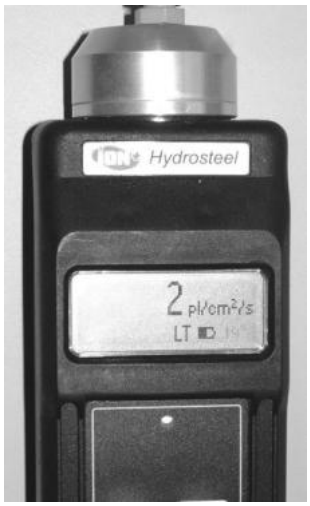
- The location for carrying out this test must have an ambient atmosphere that is distant from sources of hydrogen release to the atmosphere.
- Because the flood leak unit contains a low concentration of hydrogen gas it is important that the air in the environs of the calibration equipment is well ventilated.
- The temperature in the environs should be stable and the Hydrosteel equilibrated to the ambient temperature.

This is performed using a flood leak of 100 ppm of hydrogen gas in air mixture. This gas has a tolerance of ±10 ppm. The Hydrosteel provided readings in flux units of pl/cm$^2$/s or nl/ cm$^2$/s.

With the LT probe selected readings should be between 280 pl/cm$^2$/s and 380 pl/cm$^2$/s.

With the HT probe selected readings should be between 2200 pL/cm$^2$/s and 3000 pL/cm$^2$/s.

1) Switch unit on and let it complete the stabilisation count down and zero. Note the probe type indicated by the analyser display ('LT' or 'HT').
2) Ensure that the temperature reading in the bottom right hand corner is not flashing. This indicates that the sensor in the Hydrosteel is currently undergoing a temperature change, which may create a temporary shift in the background flux.
3) Ensure that the flux reading is stable and approximate zero (<5pl/cm$^2$/s for LT probe or 30 pL/cm$^2$/s for HT probe selection). In exceptional circumstances base line drift occurs due to the continuous presence of hydrogen background.

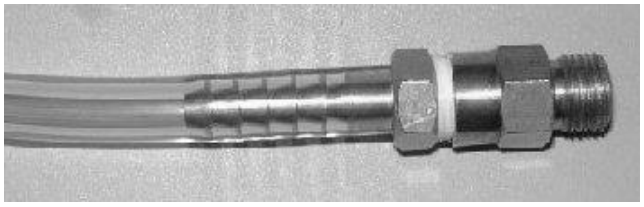


## 5 - Routine Maintenance

4) Manually fit the regulator to the gas bottle to finger tightness.

5) Press fit the clear tube to the to the regulator

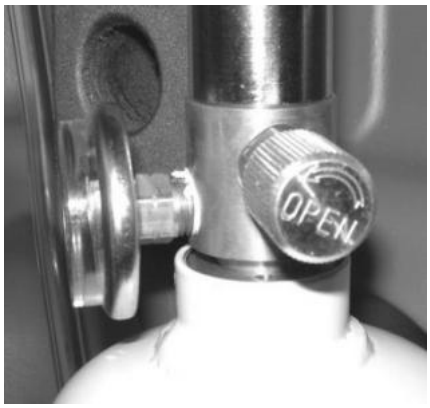
6) Press the barb of the flood leak adapter into the other end of the tube



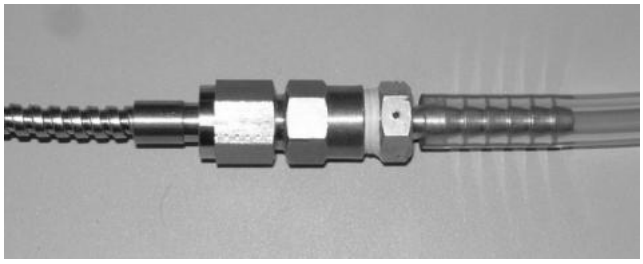
## 5 - Routine Maintenance

7) Check the pressure on the regulator is not zero. If the gas bottle becomes empty then please contact ION science toarrange a replacement. (The 150ml flood leak will drop once the pressure in the gas bottle drops below 4 bar 60psi.

8) Open the regulator. By turning the valve knob as indicated.

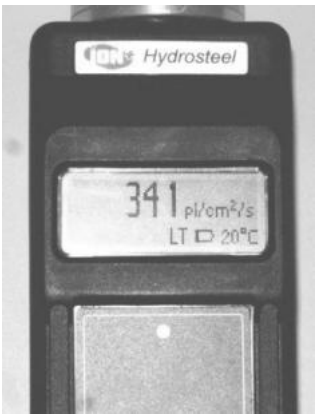



9) Connect the Hydrosteel 6000 analyser to the 2 ft LTR sample tube then connect the end of the sample tube to the flood leak as shown .



# 5 - Routine Maintenance

10)Leave the instrument connected for 1 to 2 minutes for the reading to stabilise.
11) For the LT probe the readings should be between 280pl/cm$^2$/s and 380 pL/cm$^2$/s. For the HT probe the between 2200 pL/cm$^2$/s and 3000 pL/cm$^2$/s.




12)If the reading is out side the limits stated above, the Hydrosteel analyser will need to be returned to ISL for service and calibration. In this caseti is a good idea to retest the hydrogen calibration after checking that all connections have been made securely, there is sufficient gas pressure in the gas bottle and that the instrument was zeroed in clean air free from any hydrogen background.
13)On completion of test disconnect all tubing and fittings and return to storage. IMPORTANT: ensure the regulator is closed (see step 8).

## 5.2 Battery Replacement

When the battery symbol flashes, low battery power exists, and the batteries must be replaced. If the instrument is left running until the batters fall bellow the operating voltage the instrument will restart then sense the battery voltage is too low where will flash the start up screen before displaying the messafe battery voltage too low" and switching off.
If the instrument is switched on with extremely low(but not dead) batteries one of a number of things may occur firstthe red LED will illuminate permanently the LCD will show a slight contrast as though the instrument is trying to witch on. However inthis state the instrument will not respond to key presses. Second the instrument may display and hang at the start up screen. Again the instrument will not respond to key presses. Third the instrument will start recognisethat the battery voltage is too low and switch of in the same way thatit does when the batteries die.

**1** Using the battery screwdriver provided, remove the battery cover at the

underside of the analyser.

2 Remove the exhausted batteries from the battery tray and replace with four new AA alkaline batteries.
**Note**: For the correct battery orientation, follow the symbols marked on the tray. Ensure that the flying power lead is securely fastened to the battery tray.

3 Refit the tray into the analyser body.
To save power, always turn offthe analyser when not in use.

# 5 - Routine Maintenance

## 5.3 Probe plate Replacement

**Low temperature collector plate replacement**

1 Unscrew the 1/8" nut on the collector plate sample tube to the bulkhead fitting on the back of the probe assembly.

2 With the collector plate face facing towards you twist the collector plate clock wise 45° relative to the probe assembly.
3 Slide the collector plate central spindle out of the central hole in the probe assembly.
4 Thread the gas sample tube from the collector through the leather hole in the probe assembly.
5 To secure the new collector plate, carry out the steps 4, 3, 2 and 1 in reverse.

**High temperature collector plate replacement**

1 Manually unscrew the collector handle from the assembly. Unscrew the HT sampling tube from the HT probe. (The handle unscrews below the white heat shield– please also see illustration onpage 10).
2 Using the 2.5 mm hexagonal screwdriver from the HT-kit box, unscrew the hexagonal collector plate locking screw, to release the collector plate from the bracket. Remove the plate.

3 Remove a new HT-R collector plate from the kit box. Handle the collector plates carefully. Being designed for maximum flexibility, they are liable to permanently deform if dropped or mishandled.
4 Insert the collector plate capillary into the collector assembly until the back of the plate contacts the magnets. If the capillary is obstructed, the collector plate locking screw may require further loosening with the 2.5 mm hexagonal screwdriver.
5 Lock the collector plate into position using the hexagonal screwdriver. Re-connect the HT sample tube nut onto the new collector plate until finger tight. Screw into place the probe handle.

# 5 - Routine Maintenance

## 5.4 Cleaning

**Warning**; Organic solvents such as IPA should not be used to clean the analyser or collector plates. The solvent vapour in strong concentrations may affect the sensor readings.

Attention must be made to keep the following areas clean:
1. All pneumatic joints
2. Analyser inlet
3. Surface of collector plate.
4. Bottom of probe assembly collector plate free from grit and metal filings that may be collected by magnetic attraction.

### Cleaning general

Clean the analyser and equipment using a damp cloth and mild detergent. Care must be taken around the analyser inlet and all pneumatic openings (sample tube etc.) to ensure that water does not enter. Dry immediately with suitable towel.

### Cleaning magnets

The magnets may with time attract magnetic and ferromagnetic particles. These can easily removed using an air jet from a typical air supply (100 psi / 7 bar). Simply play the jet across the surface wiping where necessary to blow the particles away.

# Appendix A

## Hydrosteel 6000 LT-R Technical Specifications

| Dimensions | |
|---|---|
| **Analyser:** | 320 x 60 x 50 mm |
| **Probe extension:** | 15 cm high x 150 mm dia. |
| **Collector:** | 20 cm high x 150 mm dia. |
| | |
| Power requirements | |
| **Batteries:** | 4 x 1.5 V AA alkaline |
| **Time operable with batteries:** | 30 hr occasional, 40 hr continuous Monitoring |
| | |
| Environmental operating conditions | |
| **Ambient temperature range:** | 15 °F to 120 °F (-10 °C to +50 °C) |
| **Test gas humidity tolerance:** | continuous 15% to 100% non-condensing, <15% for a few hours |
| **Measurement surface:** | Steel of >3.5-inch diameter cross section.<br>temperature range < 230 °F (110 °C)<br>265°F (130°C) is possible for quick spot measurements only. |
| **Test gas pressure tolerance:** | ±5% ambient pressure |
| | |

## Appendix A

# Analyser specification

**Notes**: Volumetric specifications are quoted at 20 °C and one atmosphere ambient pressure.

Pre-set input flow, deploying 27-inch (70 cm) gas sampling conduit and LT-R collector unless otherwise specified.

1 pl = $10^{-12}$ litres

| | | | |
|---|---|---|---|
| **Full range:** | 0-2500 pl/cm$^2$/s. | | |
| **Resolution:** | < 2 pl/cm$^2$/s hydrogen emanating from steel | | |
| **Linearity:** | Linear over full range | | |
| **Reproducibility:** | 5% or 1 pl/cm$^2$/s, whichever is greater. | | |
| **Rate of response:** | | | |
| **%FSD** | **1%** | **50%** | **90%** |
| 27-inch (70 cm) conduit | 8 s | 24 s | 42 s |
| 78-inch (200 cm) conduit | 17 s | 36 s | 55 s |
| **Cross sensitivity** (versus hydrogen = 100%): | | | |
| CO <1%; $H_2S$ <20%; NO, <30%; $C_2H_4$, 80% | | | |
| **Relative response** (versus100 ppm @ 20 °C = 1.00): | | | |
| 30 °C = 1.03; 40 °C =1.11; 50 °C =1.21 | | | |
| **Pre-set input flow rate:** | 30 ±1 ml/min | | |
| **Background signal drift:** | <50 pl/cm$^2$/s equivalent per year,<br><1 pl/cm$^2$/s per hr.<br>< 0.5 pl/cm$^2$/s per °C | | |
| **Operating lifetime:** | sensor, 1 year pump, >1500 hr | | |

## Appendix B

Analyser Menu Options – start up mode

The following selections can only be made instart-up mode – up to 90 seconds from turning the instrumenton.

| Key press | Main Function | Countdown | Key options |
|---|---|---|---|
| O | Power up, displays system status, time and power status, | 8 s | none |

After 8 s, while the promptstart-up mode is displayed, press:

| | | | |
|---|---|---|---|
| D | Display data log summary | 10 s | D |
| DD | Data download instructions | 10 s | D |
| DDD | Data download | 30 s | D |
| DDDD | Cancel download, and return to Start-up mode | - | none |

Also during start-up mode, you can access the following:

| | | | |
|---|---|---|---|
| DS | Clear memory | 4 s | any |
| O | Turn analyser off | 4 s | O |
| OO | Zero analyser and enter operating mode | 4 s | O |
| SD | Select time/date (clock) parameters sequentially | 60 s | O, S, D |
| SSD | Select units of measurement | 10 s | O, S, D |
| SSSD | Select probe | 60 s | O, S, D |
| SSSSD | Select choice of temperature scale | 60 s | S, D |
| SSSSS | exit, and return to start-up mode | - | none |

## Appendix B

Analyser Display Options – operating mode

| Key press | Main Function | Countdown | Key options |
|---|---|---|---|
| | After 80 s of start-up mode, the analyser enters operating mode. | | |
| D | Display data log summary | 5 s | D |
| DD | 60 s log mode (5 s data intervals) | 60 s | D |
| DDD | Indefinite data log (to 10 min data intervals) Select D to end logging. | inde-finite | D, low battery, log full |
| #D...DS | Access log statistics (file length, maximum flux, slope of present flux, end log mode, and return to operating mode | 5 s | none |

# - only selectable after 1 minute of data logging

| | | | |
|---|---|---|---|
| | From operating mode, you can identify a zone for data logging | | |
| DS | Select zone | 10 s | S, D, O |
| O | Return to operating mode | 1 s | none |
| | From operating mode, you can download data to your PC: | | |
| SD | PC Connect: analyser communicates with PC via IRDA link | inde-finite | D |
| SD | return to operating mode | 1 s | none |

## Update Log

| Manual Version | Amendment | Date updated | Instrument Firmware | PC Software |
|---|---|---|---|---|
| Hydrosteel 6000 | Update log added in back of manual | 23/12/08 | V2.38 | V3.25 |
| Hydrosteel 6000 | Page 5 – Specification updates for AT-S and HT-S Probes. | 13/01/09 | V2.38 | V3.25 |