



## User Manual **Hydris**

v. 1.4.2 19/03/21



# Contents

<b>1.</b>	<b>Introduction</b>	<b>1</b>
1.1	Document Identification	1
1.2	System Overview	1
<b>2.</b>	<b>Safety and Usage Notes</b>	<b>2</b>
2.1	Skilled Personnel	2
2.2	Danger Notices	2
2.3	Proper Usage	2
2.4	Personal Protective Equipment	3
2.5	Safety Regulations	3
2.6	Looking After the Instrument	3
2.6.1	Cleaning Notes	4
2.7	Procedures for Maintenance and Repair	4
2.8	Transport	4
2.8.1	Packaging of the Instrument	5
2.9	Guidelines for Handling Electrostatic Discharge	5
2.10	Restriction of Hazardous Substances (RoHS) Regulations	6
2.11	Waste Electrical and Electronic Equipment (WEEE) Regulations	6
2.12	Disposal of instrument or parts	6
2.13	CE Declaration of Conformity	7
<b>3.</b>	<b>System Description</b>	<b>8</b>
3.1	Different Components	8
3.2	Analysis Technique	9
3.3	Measurement Modes	9
3.3.1	Equilibrium Only	10
3.3.2	Quick-Check	10
3.3.3	Select Measurement Mode	11
<b>4.</b>	<b>Hardware Design</b>	<b>13</b>
4.1	Processor Unit	13
4.1.1	Technical data Processor Unit	13
4.1.2	In- and outputs Processor Unit	14
4.1.3	Level 2 connections	16
4.2	Pneumatic Unit	17
4.2.1	Technical Data Pneumatic Unit	17
4.2.2	Front view	18
4.2.3	Inside view	19
4.2.4	In- and outputs Pneumatic Unit	22
4.3	Pneumatic Hose	24
4.4	Lance	25
4.5	Hydris Probe	26

<b>5.</b>	<b>User Interface Design</b>	<b>27</b>
5.1	User Interface	27
5.2	User inputs and outputs	29
5.2.1	Pneumatic Unit	29
5.2.2	Processor Unit	29
5.3	User levels	30
5.4	System tools	30
<b>6.</b>	<b>Installation</b>	<b>32</b>
6.1	System requirements	32
6.2	Where to install the system	32
6.3	Starting up the system	33
6.4	Connect to the processor unit remotely	33
<b>7.</b>	<b>Operation</b>	<b>34</b>
7.1	Operator screen	34
7.2	Performing a measurement	35
7.2.1	Dipping the Probe Correctly	36
7.2.2	Measurement Procedure	37
7.2.3	Entering the heat number	48
7.2.4	Entering the K/f value	48
7.3	Evaluating the results	51
7.3.1	During the measurement	51
7.3.2	Measurement final result	52
7.3.3	History	61
<b>8.</b>	<b>Settings</b>	<b>62</b>
8.1	Settings screen	62
8.2	General settings	62
8.2.1	Instrument	63
8.2.2	Customer info	63
8.2.3	Visualization	64
8.2.4	Regional settings	65
8.3	Parameters	65
8.3.1	Resetting all parameters	65
8.3.2	Correction settings (PIC/TIC)	66
8.3.3	Immersion depth compensation	66
8.3.4	Pneumatic control	67
8.3.5	Measurement	68
8.3.6	Equilibrium	68
8.3.7	QuiK-Read	69
8.4	Network	70
8.4.1	Instrument network settings	70
8.4.2	Pneumatic unit network settings	71
8.4.3	Network summary	71

<b>9.</b>	<b>Level2 Communication</b>	<b>73</b>
9.1	Configure Level2 communication	73
9.2	Device settings	76
9.2.1	Serial	76
9.2.2	TCP Settings	76
9.2.3	Ethernet/IP	77
9.2.4	Modbus	77
9.2.5	Profibus	78
9.2.6	Profinet	78
9.3	Default Telegrams	78
9.3.1	Serial/TCP protocols	78
9.3.2	Industrial Protocols	87
9.4	Telegram Construction	89
9.4.1	Free text	89
9.4.2	Control characters	89
9.4.3	Variables	90
9.4.4	Level2 variables	91
<b>10.</b>	<b>Optional in- or outputs</b>	<b>97</b>
10.1	Connections for Profibus	97
10.2	Connections for Modbus	98
10.3	Connections for Ethernet/IP	99
10.4	Connections for Modbus TCP	100
10.5	Connections for Profinet IO	101
<b>11.</b>	<b>Maintenance</b>	<b>103</b>
11.1	Maintenance screen	103
11.2	Maintenance plan	104
11.3	Maintenance kit	105
11.4	Daily maintenance procedure	106
11.5	Air test	106
11.5.1	Running an air test	107
11.6	Leakage test	108
11.6.1	Run a leakage test	110
11.6.2	Leakage test results	111
11.6.3	Influence of leaks	112
11.7	Calibration	112
11.7.1	Run a calibration	114
11.7.2	Calibration result	116
11.7.3	Troubleshooting during calibration	118
11.7.4	Using Argon as a carrier gas	118
11.8	Test gas measurement	119
11.9	Manual Access	122
11.10	Diagnostics overview	123

11.11	Replace the tar filter	124
11.12	Replace the moisture filter	125
<b>12.</b>	<b>Troubleshooting</b>	<b>126</b>
12.1	Leakage	126
12.1.1	Condition	126
12.1.2	Cause	126
12.1.3	Check the filter	126
12.1.4	Check the pump	126
12.1.5	Check the valves	126
12.2	Error messages	126
12.2.1	Put probe on probeholder	126
12.2.2	Valve	127
12.3	No stable zerosetting	128
12.3.1	Condition	128
12.3.2	Cause	128
12.3.3	Procedure	128
12.4	Repairing a lance	128
12.4.1	Remove the handle and lance end	128
12.4.2	Remove the probe holder tube and contact block assembly	129
12.4.3	Remove the contact block assembly	129
12.4.4	Replace probe holder tube	130
12.4.5	Replace contact block assembly	130
12.4.6	Connect copper tubes and lance end	130
12.4.7	Fix the handle	130
12.4.8	Fix the contact block	130
<b>13.</b>	<b>Spare parts</b>	<b>131</b>
<b>14.</b>	<b>Appendix</b>	<b>132</b>
14.1	ASCII Table	132

## List of Figures

Figure 1:	System overview	1
Figure 2:	Thermal conductivity of various gases	9
Figure 3:	Typical equilibrium measurement result	10
Figure 4:	Tresholds zone for Quick Check measurement	11
Figure 5:	Quick check measurement	11
Figure 6:	Back view ROW Processor Unit	14
Figure 7:	Back view US Processor Unit	15
Figure 8:	Front view Pneumatic Unit	18
Figure 9:	Inside view Pneumatic Unit	19
Figure 10:	Overview of contacts for components on the electronics board	21
Figure 11:	Overview of Extern Fuses inside the pneumatic unit	22
Figure 12:	Bottom view Pneumatic Unit	22
Figure 13:	Lance composition	25
Figure 14:	Main user interface Pneumatic Unit	27
Figure 15:	Main user interface Processor Unit	28
Figure 16:	System tools screen	30
Figure 17:	Operator screen	34
Figure 18:	Consequent measurement procedure steps indicated in the graph	52
Figure 19:	Typic result graph	53
Figure 20:	History screen	61
Figure 21:	Settings screen	62
Figure 22:	Instrument settings screen	63
Figure 23:	Customer info screen	63
Figure 24:	Visualization screen	64
Figure 25:	Regional settings screen	65
Figure 26:	Example of Industrial Input for Profibus	88
Figure 27:	Example of Industrial Output for Profibus	89
Figure 28:	Maintenance screen	103
Figure 29:	Manual Access screen	122
Figure 30:	Pneumatic unit with tar filter block mounted next to the moisture filter	124

## List of Tables

Table 1:	Technical data ROW Processor Unit	13
Table 2:	Technical data US Processor Unit	14
Table 3:	Overview in-and outputs ROW Processor Unit	15
Table 4:	Overview in- and outputs US Processor Unit	16
Table 5:	Level 2 connections ROW Processor Unit	16
Table 6:	Level 2 connections US Processor Unit	17
Table 7:	Technical data Pneumatic Unit	17
Table 8:	Extern Fuses	22
Table 9:	Overview in- and outputs pneumatic unit	23
Table 10:	Overview measurement status on pneumatic unit	29
Table 11:	Overview measurement status on processor unit	29
Table 12:	Influence of immersion depth and thickness of slag on the hydrogen content measured	36
Table 13:	Display of messages during the measurement	37
Table 14:	Summary of the measurement procedure	47
Table 15:	Description of measurement result: live tab	51
Table 16:	Description of measurement result: measurement tab	53
Table 17:	Description of measurement result: details tab	54
Table 18:	Correlation between Hydrogen content during flush B and the final Hydrogen content	55
Table 19:	General settings menu	62
Table 20:	Serial device settings	76
Table 21:	TCP Client settings	76
Table 22:	TCP Server settings	76
Table 23:	Ethernet/IP settings	77
Table 24:	Modbus RTU settings	77
Table 25:	Modbus TCP settings	77
Table 26:	Profibus settings	78
Table 27:	Profinet	78
Table 28:	Input telegrams for Profibus, Profinet, Ethernet IP and Modbus TCP	87
Table 29:	Industrial output telegram for Profibus, Profinet, Ethernet IP and Modbus TCP	88
Table 30:	Available variables for telegrams	91
Table 31:	QuiK-Read measurement error codes	93
Table 32:	Equilibrium measurement error codes	93
Table 33:	Measurement error codes	94
Table 34:	Combined errors	94
Table 35:	Measurement type codes	95

Table 36:	System state codes	95
Table 37:	System state detail codes	95
Table 38:	Input process status feedback (INPUTPROCESSFLAGS)	96
Table 39:	Profibus Connector (DB9F)	97
Table 40:	Profibus Communication LED	97
Table 41:	Profibus Device Status LED	98
Table 42:	Modbus Connector (DB9F)	98
Table 43:	Modbus Communication LED	98
Table 44:	Modbus Device Status LED	99
Table 45:	Network status LED Ethernet connector	99
Table 46:	Module status LED Ethernet connector	99
Table 47:	LINK/Activity LED Ethernet connector	100
Table 48:	Network status LED Modbus TCP connector	100
Table 49:	Module status LED Modbus TCP connector	100
Table 50:	LINK/Activity LED Modbus TCP connector	101
Table 51:	Network status LED Profinet IO connector	101
Table 52:	Module status LED Profinet IO connector	101
Table 53:	LINK/Activity LED Profinet IO connector	102
Table 54:	Example Hydris® checkbook	104
Table 55:	Overview of maintenance and spare parts sets	105
Table 56:	Checklist leak detection	111
Table 57:	Influence of leaks on the measurement results	112
Table 58:	Calibration result fields explained	116
Table 59:		119



# 1. Introduction

## 1.1 Document Identification

This manual provides information required to use and maintain the Hydris<sup>®</sup> instrument. It is written for technically skilled personnel such as engineers, programmers, or maintenance specialists who have been specially trained and who have the specialized knowledge required in the field of instrumentation, electronics and control.

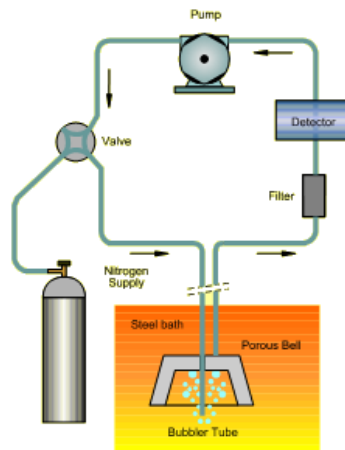
This manual is an integral part of the instrument or device. For the sake of clarity, not all details of all versions of the instrument or device are described, nor can it cover all conceivable cases regarding installation, operation, and maintenance. If you require further information or face special problems that have not been dealt with in sufficient detail in this manual, contact your local Heraeus Electro-Nite representative.

We would also point out that the contents of this manual shall not become a part of, or modify, any prior or existing agreement, commitment, or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Heraeus Electro-Nite. Any statements contained in this manual do not create new warranties or restrict the existing warranty.

## 1.2 System Overview

The Hydrogen direct reading immersion system (Hydris<sup>®</sup>) measures the hydrogen content in liquid steel using the Hydris<sup>®</sup> equilibrium detection method. A nitrogen carrier gas is injected in the steel melt and is recirculated between the melt and the pneumatic unit. It picks up hydrogen during its passage in the melt. The measurement is stopped when equilibrium is reached between the hydrogen dissolved in the melt and the hydrogen concentration in the carrier gas.

Hydris<sup>®</sup> determines the hydrogen content by means of a thermal conductivity detector, which measures the hydrogen concentration in the nitrogen carrier gas. The final hydrogen content is then calculated based on Sievert's law.



**Figure 1:** System overview

## 2. Safety and Usage Notes

### 2.1 Skilled Personnel

Only skilled personnel should be allowed to work on this instrument or device. Non-compliance with the warnings contained in this manual or appearing on the instrument or device itself can result in death or severe personal injury or damage to property. Skilled personnel includes:


- System planning and design engineers who are familiar with the safety concepts of automation equipment, instruments, or electronic devices.
- An engineer who can calculate the strength of the structure to mount the installation if necessary.
- Operating personnel who have been trained to work with automation equipment, instruments, or electronic devices, and are conversant with the content of the manual in as far as it is connected with the actual operation of the instrument or device.
- Commissioning and service personnel who are trained to repair such automation equipment, instruments, or electronic devices, and who are authorized to energize, de-energize, clear, ground, and tag circuits, equipment, and systems in accordance with established safety practices.


### 2.2 Danger Notices

The notices and guidelines that follow are intended to ensure personal safety, as well as protecting the instrument or device and any connected equipment against damage.

The safety notices are warnings for protection against loss of life (yours or service personnel) or for protection against damage to property and are highlighted in this manual by the terms and pictograms defined here. The terms used in this manual and marked on the instrument itself have the following significance:

 **DANGER:** Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

 **Warning:** Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

 **CAUTION:** Indicates a hazardous situation that, if not avoided, could result in minor or moderate personal injury or property damage.


 **Note:** Indicates important information about the product, its operation, or a part of the manual to which special attention is drawn.


### 2.3 Proper Usage


The instrument or instrument components may only be used for the applications described in the manual or the technical description, and only in combination with the equipment, components, and devices of other manufacturers as far as this is recommended or permitted by Heraeus Electro-Nite.

The instrument described has been developed, manufactured, tested, and the manual compiled in keeping with the relevant safety standards.

Consequently, if the handling instructions and safety guidelines described for planning, installation, operation, and maintenance are followed, the instrument or device, under normal conditions, will not be a source of danger to property or life.

 **Warning:** When the equipment is used in a manner not specified by Heraeus Electro-Nite in this manual, the protection provided by the equipment may be impaired.


 **CAUTION:** This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

 **Note:** Use only original Heraeus Electro-Nite Hydris®-Probes. Otherwise no liability for incorrect measurements or malfunctions can be accepted.

## 2.4 Personal Protective Equipment

The PPE's required for working on the instrument or device are:



 **CAUTION:** the pneumatic unit buzzer produces noise with a strength higher than 80 dB for more than 3 seconds. Hearing protection must be worn when using the instrument.

## 2.5 Safety Regulations

The unit must be connected in compliance with the VDE 0100 "Regulations for establishing high voltage equipment with mains voltages below 1000 V".

### **DANGER:**

- Before opening the equipment, it is essential that the mains voltage is switched off to all channels or that the mains plug is disconnected.
- Connected devices (signalling system, horn) could have their own power supply, which must also be disconnected. Work on active system components may only be carried out with the utmost care by properly trained and qualified personnel.
- To reduce the risk of electrical shock, do not remove cover or back. Do not open the device. No serviceable parts inside. Refer to qualified service personnel.

The area in which the Hydris® will be installed needs to be well ventilated in order to prevent an accumulation of argon or nitrogen around the machine. On no account may other gases be added. (E.g. hydrogen). Always check local environmental laws and vent according to national laws.

## 2.6 Looking After the Instrument

The Hydris® measurement system requires little maintenance. However, since it is subject to thermal and mechanical stress, it is recommended you check it once a week to ensure accurate results.

## 2.6.1 Cleaning Notes

The Hydris<sup>®</sup> instrument can be cleaned with a damp cloth and mild detergent. This applies to the cabinet exterior only. Prior to cleaning the Hydris<sup>®</sup> cabinet exterior with a damp cloth and mild detergent, disconnect all sources of power from the Hydris<sup>®</sup> cabinet.

## 2.7 Procedures for Maintenance and Repair

If measurement or testing work is to be carried out on an active unit, your national accident prevention rules and regulations must be observed. Use only suitable electrical tools.

### **Warning:**


- Unauthorized opening of equipment and improper repairs can result in loss of life or severe personal injury as well as substantial property damage.
- Repairs to an item of automation equipment may only be carried out by Heraeus Electro-Nite service personnel.

### **Note:**

- For replacement purposes, use only parts or components contained in the Spare Parts List section of this manual.
- Only use the fuse types specified in the technical specifications or the maintenance instructions of this manual.

## 2.8 Transport

Report damage during or immediately after delivery to the transport company and to Heraeus Electro-Nite. Take all necessary steps to prevent further damage.

 **CAUTION:** *The Hydris<sup>®</sup> instrument is too heavy to be lifted by one person. Lift the instrument with two persons using the lifting handles foreseen at both sides of the instrument.*



### 2.8.1 Packaging of the Instrument

Since the instrument or device is a high-quality electronic measurement unit, it should only be dispatched in its original packing. If the original packing is no longer present, then it is advisable to properly pack the device in a sufficiently large box lined with a shock-absorbing material such as PUR foam, polystyrene flakes, or similar. The shock-absorbing layer should have a minimal thickness of 10cm on all sides. Before packing the instrument, it must be wrapped in paper or plastic film.

Anti-static packing material must always be used when storing and dispatching ESD-sensitive modules and components. If the container itself is not conductive, the modules must be wrapped in a conductive material such as conductive foam, antistatic plastic bag, aluminum foil, or paper. Normal plastic bags or foil should not be used under any circumstances. For modules with built-in batteries, ensure that the conductive packing does not touch or short-circuit the battery connections: if necessary, cover the connections with insulating tape or material.

For overseas transportation, the unit should be welded into an air-tight plastic film, ideally with a desiccant added. These packing recommendations also apply when returning the unit to Heraeus Electro-Nite.

## 2.9 Guidelines for Handling Electrostatic Discharge

Electronic VLSI components are, by their nature, very sensitive to over voltages and thus to electrostatic discharge (ESD).



This pictogram and warning label is used on cabinets, sub-racks, and packing and suggests that modules are susceptible to ESD

Before starting maintenance or installation make sure that you have sufficient protection against ESD.

Electronic devices can be destroyed by voltage and energy levels that are far below 200V, the level perceptible to human beings (ie 2000V). Such voltages can occur when a component or a module is touched by a person who has not been electrostatically discharged. In most cases, the components subjected to such over voltages, cannot be immediately detected as faulty. ESD problems are in many cases dormant as they can manifest themselves after a long time of normal operations.

## 2.10 Restriction of Hazardous Substances (RoHS) Regulations

All electrical devices sold in the European market from the July 1, 2006 must comply with EU Directive 2002/95/EC, and RoHS 2 directive 2011/65/EU, on the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) as well as the national laws derived from it. According to the definition in Annex I of EU Directive 2012/19/EU WEEE, Heraeus Electro-Nite measuring instruments and analysis devices belong to category 9 – industrial monitoring and control instruments.

All Heraeus Electro-Nite instruments placed on the market after 1 July 2006 do not contain materials prohibited according to the RoHS directive.

## 2.11 Waste Electrical and Electronic Equipment (WEEE) Regulations



According to the EU Directive 2012/19/EU WEEE, all electrical devices sold in the European market from the 13 August 2005 must be marked with a special symbol. This symbol (crossed out waste disposal receptacle with thick black bar underneath) indicates to the customer that the device must not be placed in household waste but must be either deposited at a collection place for commercial scrap or returned to the manufacturer.

Heraeus Electro-Nite devices are exclusively for industrial commercial use and may not be transferred to private use. Devices must be disposed of according to local or national, statutory regulations for commercial electrical scrap. You must also follow the EU Directive WEEE regulations and their national conversion. If in doubt, ask your local Heraeus Electro-Nite representative.

## 2.12 Disposal of instrument or parts

If components of the instrument or device have to be replaced due to malfunction, these components have to be returned to Heraeus Electro-Nite.

In general, old Heraeus Electro-Nite devices can be disposed by simple shipping it back to Heraeus Electro-Nite premises. In this case the customer only pays for the transport and disposal costs will be handled by Heraeus Electro-Nite.

If the instrument will be disposed at your own premises, think about the following recycling issues. The device consists of several components that can be disposed of separately:

- The electronic cards for electronic recycling
- The housing for metal recycling

For further disposal information, always follow the local legislation.

## 2.13 CE Declaration of Conformity

Hereby, Heraeus Electro-Nite declares that this equipment is in compliance with the CE-directives on Safety, EMC and RF Exposure requirements. The full text of the EU Declaration Of Conformity is available at the following internet address: [https://www.heraeus.com/en/hen/downloads\\_1/product\\_downloads.html#tabs-862239-1](https://www.heraeus.com/en/hen/downloads_1/product_downloads.html#tabs-862239-1). To maintain compliance with the regulatory requirements, only use Heraeus Electro-Nite accessories intended for use with this product, installed according to the instructions in this manual.

The pneumatic unit is manufactured by:

Asteelflash Bonn GmbH  
Allerstraße 31  
53332 Bornheim-Hersel  
Germany

The processor unit is manufactured by:

Cortexon B.V.  
Eisenhowerweg 12  
5466 AC Veghel  
The Netherlands

## 3. System Description

### 3.1 Different Components

The Hydris<sup>®</sup> probe is immersed into the steel melt by means of a hand-guided or manipulator guided immersion lance. A pneumatic cable connects the Hydris<sup>®</sup> lance with the Hydris<sup>®</sup> pneumatic unit. The Hydris<sup>®</sup> pneumatic unit injects a nitrogen carrier gas through the Hydris<sup>®</sup> pneumatic lance and the attached Hydris<sup>®</sup> probe into the steel melt. The carrier gas is continuously circulated through the measuring system until an equilibrium is reached between the hydrogen dissolved in the steel melt and the hydrogen in the carrier gas. The hydrogen content is continuously measured and displayed using a connected processor unit and the result is displayed on the pneumatic unit as well as the processor unit when the equilibrium has been reached.



#	Name	Function
1	processor unit	controls the pneumatic system and displays the hydrogen result
2	pneumatic unit	circulates the nitrogen carrier gas and measures the hydrogen by means of its thermal conductivity detector
3	pneumatic hose	connects the pneumatic unit to the lance
4	lance	used for immersing the probe in the steel bath
5	disposable probe	contains the Hydris <sup>®</sup> insert

## 3.2 Analysis Technique

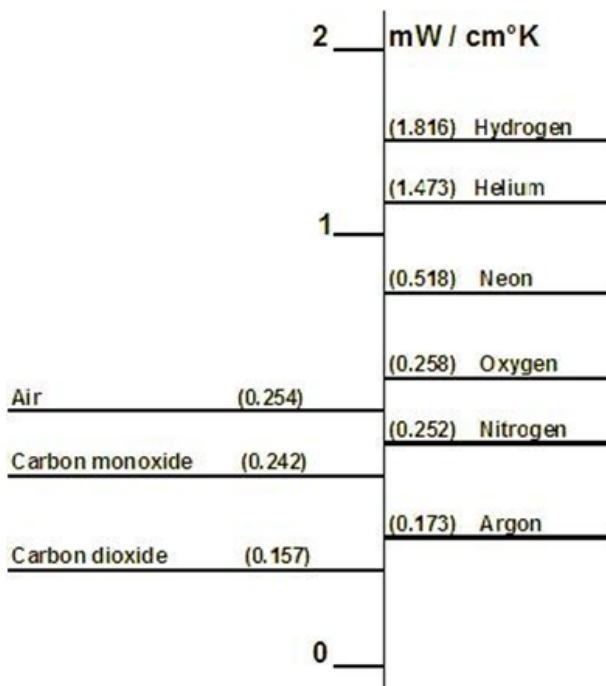
The hydrogen content is analysed with a thermal conductivity detector. Due to the high thermal conductivity of hydrogen, the hydrogen partial pressure can easily be measured. The hydrogen partial pressure is converted to the hydrogen content of the melt in accordance with Sievert's law, which states that:

$$H = K / f * \sqrt{PH_2}$$

Where:

- H = Hydrogen in ppm
- PH<sub>2</sub> = Hydrogen partial pressure in hPa
- K = Equilibrium constant of the reaction
- f = Hydrogen activity coefficient

The following shows the thermal conductivity of various gases:



**Figure 2:** Thermal conductivity of various gases

## 3.3 Measurement Modes

The following measurement modes (also known as trace evaluation methods) are available:

- Equilibrium only
- Quick-Check

### 3.3.1 Equilibrium Only

The Equilibrium method is the standard measurement mode, the benchmark or reference method for determining all mathematical algorithms used to calculate the final hydrogen content.

The measurement procedure is as follows:

- 1 Flush A: The nitrogen carrier gas is injected into the melt (through the vacuum side and through the blow side) to remove as much slag particles and residual moisture as possible from the probe.
- 2 Flush B: The nitrogen carrier gas is recovered from the steel, but is not recirculated for a short time to allow an additional cleaning step.
- 3 Measuring: The nitrogen carrier gas is recirculated into the melt. Its hydrogen content is continuously measured by the thermal conductivity detector. Once the hydrogen equilibrium between the melt and the carrier gas has been reached, the measurement is stopped.

The following graph shows the result of a typical equilibrium measurement:

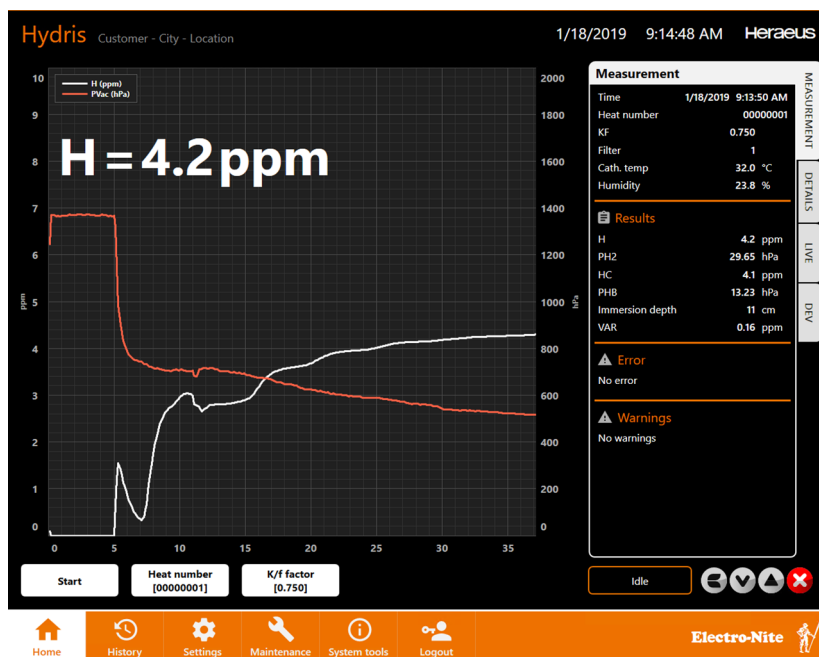


Figure 3: Typical equilibrium measurement result

### 3.3.2 Quick-Check

The Hydris® Quick-Check measurement method enables a quick determination of hydrogen, using a statistical-based prediction. The value of the prediction will determine within 15 seconds whether an equilibrium measurement is necessary. Based on Hydrogen level thresholds, comfort and risk zones can be set to have a quick predicted result or to use the accurate equilibrium method. When the

hydrogen content lies in the comfort zone between threshold 1 and 2 (see following figure) only a Quick Check measurement will be performed. When the predicted value lies in the risk zone or out of limit zone an equilibrium measurement will be performed.

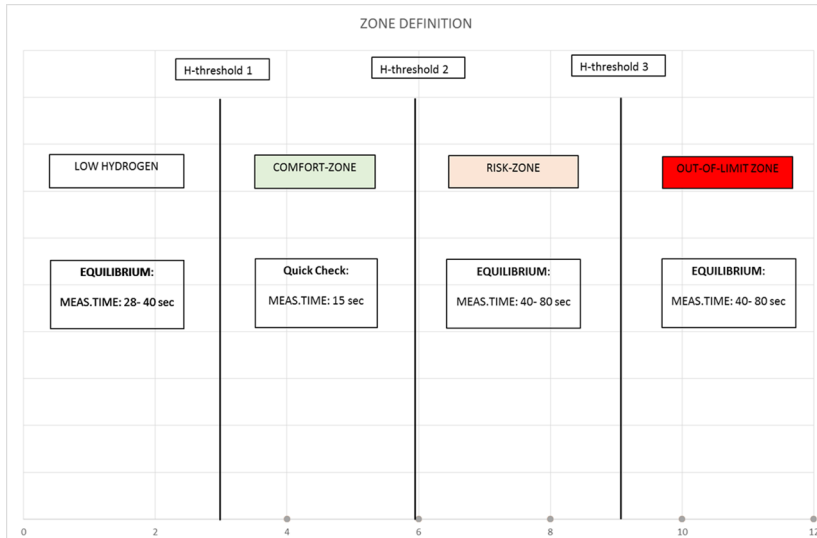


Figure 4: Thresholds zone for Quick Check measurement

In the following figure a typical quick check curve is shown.

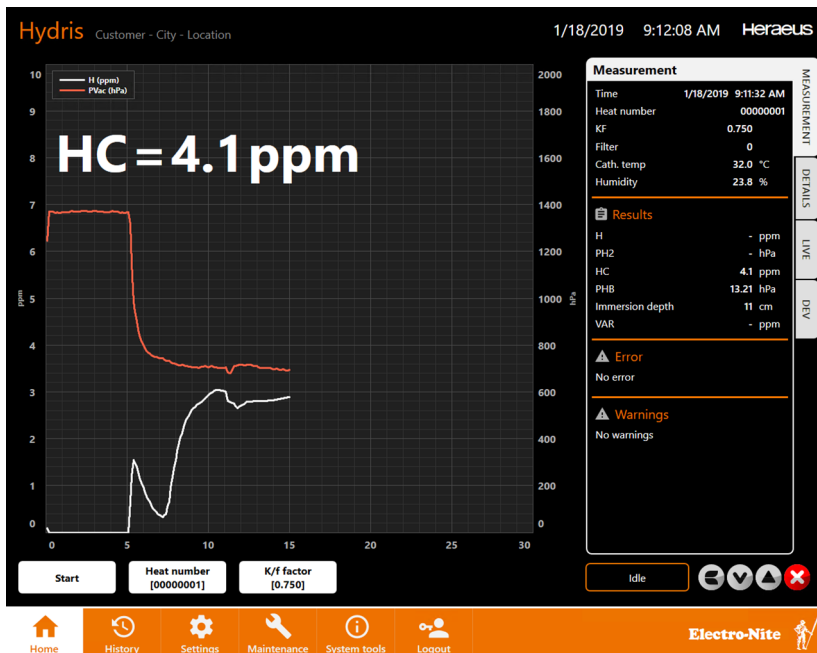


Figure 5: Quick check measurement

### 3.3.3 Select Measurement Mode

The Equilibrium method is the standard measurement mode, the benchmark or reference method for determining all mathematical algorithms used to calculate the final hydrogen content.

To check that you are using this method, [Login](#) and go to [Settings](#). Select [Parameters](#) > [Measurement](#) > [MeasurementMode](#)

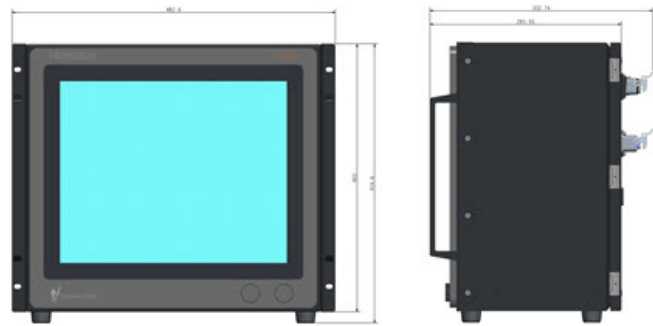
# 4. Hardware Design

## 4.1 Processor Unit

### 4.1.1 Technical data Processor Unit

**Table 1: Technical data ROW Processor Unit**

Item	Details
Power Supply	100-240V AC, 50-60Hz, 1.6-0.9A
Power Rating	40W max
Display	17" TFT colour display with touch screen
Operating Ambient Temperature Range	-10°C to +60°C
Operating Humidity Range	5 to 95 % RH non condensing
Operating Altitude	Up to 2000m
Environmental Protection	IP55
Size	Height = 416.6mm ; Width = 482.6mm ; Depth = 332.74mm

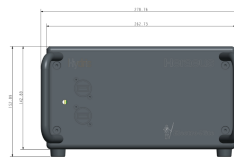


Weight

16.7 kg

**Table 2: Technical data US Processor Unit**

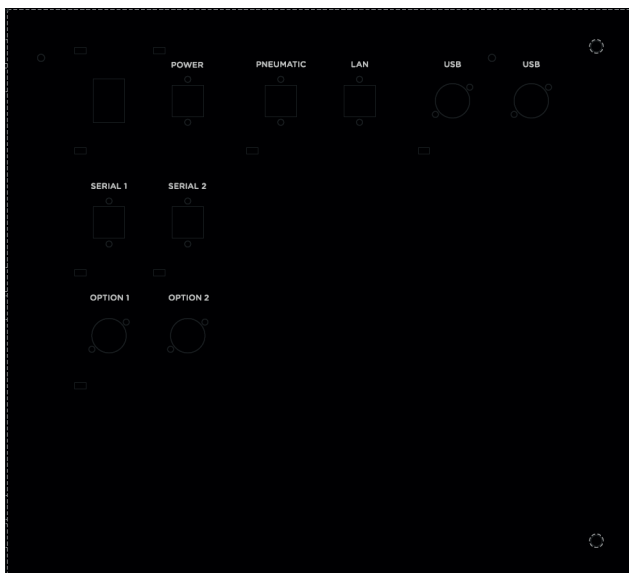
Item	Details
Power Supply	100-240VAC, 50-60Hz, 1.6-0.9A Internal fuse: 2A time lag 250V
Power Rating	25W max
Operating Ambient Temperature Range	50 - 140 °F
Operating Humidity Range	5 to 95 % RH non condensing
Operating Altitude	Up to 2000m
Size	Height = 152.89mm ; Width = 278.76mm ; Depth = 362.86mm



Weight

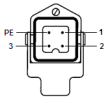
7 kg


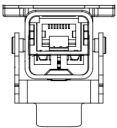
### 4.1.2 In- and outputs Processor Unit



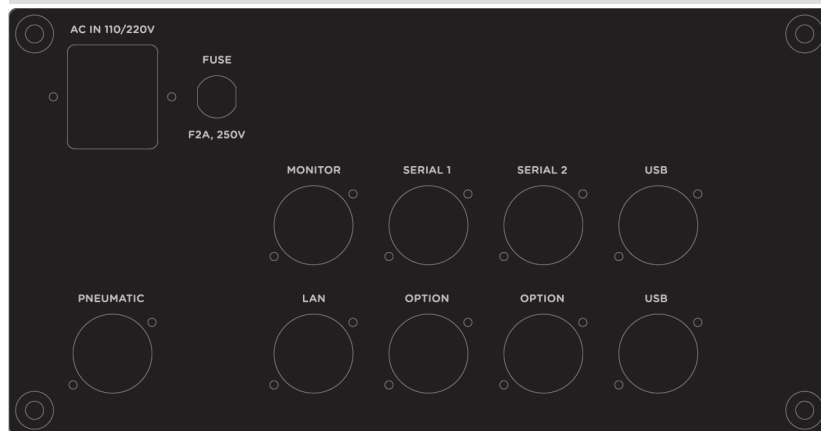
**Figure 6: Back view ROW Processor Unit**

**Table 3: Overview in-and outputs ROW Processor Unit**

Name	Connector type	Front view	Wiring scheme		
			Pin	Function	Cable colour
Power	Harting HAN 3A-M		1	L1	brown
			2	N	blue
			3	NC	-
			PE	PE	green/yellow

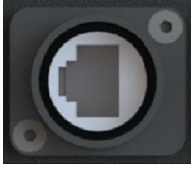
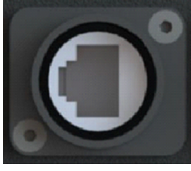
Name	Connector type	Front view	Wiring scheme	
			Pin	Function
Serial	Harting 5-pin HAN 4A-F		1	RxD-
			2	RxD+
			3	TxD+
			4	TxD-
			5	not connected
Pneumatic	Harting 3A RJ45		1	BI_DA+
			2	BI_DA-
			3	BI_DB+
			4	BI_DC+
			5	BI_DC-
			6	BI_DB-
			7	BI_DD+
			8	BI_DD-
LAN	Harting 3A RJ45			

**Note:** 2 optional connections for Profibus, Modbus RTU, Modbus TCP, Ethernet/IP or Profinet IO (SUB D9 F or Ethernet connector)



**Figure 7:** Back view US Processor Unit

**Table 4: Overview in- and outputs US Processor Unit**

Name	Connector type	Front view	Wiring scheme	
			Pin	1000Base-T
Pneumatic	Ethernet RJ45 F		1	BI_DA+
			2	BI_DA-
			3	BI_DB+
			4	BI_DC+
LAN	Ethernet RJ45 F		5	BI_DC-
			6	BI_DB-
			7	BI_DD+
			8	BI_DD-

Name	Connector type	Front view
AC IN	IEC power input switched	
Fuse	F2A, 250V	
Monitor	VGA	
Serial 1	SUB D9 M	

### 4.1.3 Level 2 connections

**Table 5: Level 2 connections ROW Processor Unit**

Connection	Connector type	Wiring scheme
TTY	Harting 09 20 004 2711	
RS232	Harting 09 20 004 2711	Pin 1: TxD, Pin 2: RxD, Pin 3: GND
Anybus	Sub D9 or RJ45	

**Table 6: Level 2 connections US Processor Unit**

Connection	Connector type	Wiring scheme
TTY	SUB D9	Pin5: TxD+, Pin4: TxD-, Pin 1: RxD+, Pin6 RxD-
RS232	SUB D9	Pin 2: TxD, Pin3: RxD, Pin 5: GND
Anybus	SUB D9 or RJ45	

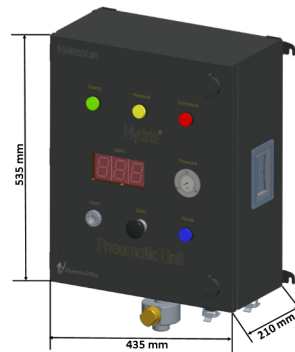
## 4.2 Pneumatic Unit

### 4.2.1 Technical Data Pneumatic Unit

**Table 7: Technical data Pneumatic Unit**

Item	Details
Measurement Time	15 to 120 seconds
Measurement Range	0.5 to 14 ppm [% H]
Measurement Accuracy	0.1 ppm in the measurement range
Display Resolution	0.01 ppm
Display Unit	ppm, LED display with digital height 45 mm
Power Supply	100-240VAC, 50-60Hz, 62VA max
Operating Ambient Temperature Range	0°C to +50°C
Operating Humidity Range	5 to 95 % RH non condensing
Operating Altitude	up to 2000m
Environmental Protection	IP55

Size



Weight

35 kg

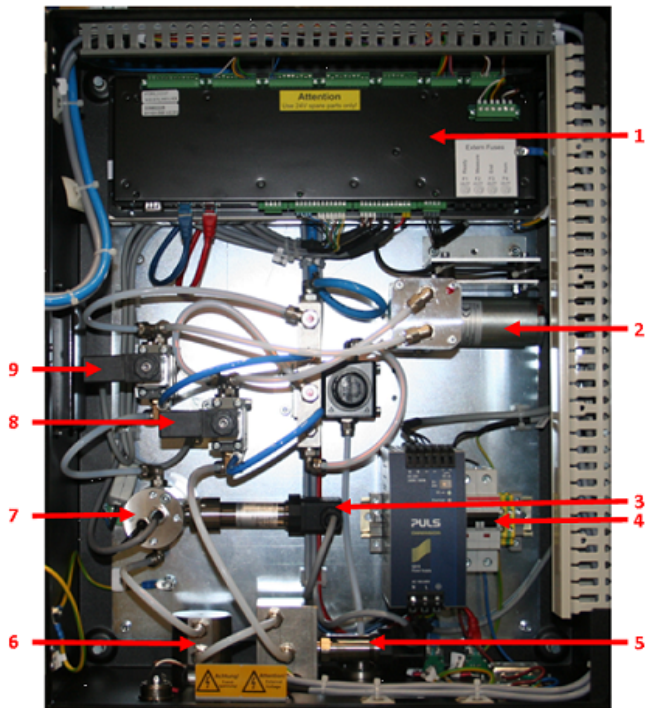
### 4.2.2 Front view



Figure 8: Front view Pneumatic Unit

1	signal lights
2	manometer
3	measurement start button
4	acoustic signal (buzzer)
5	display
6	network link to control PC
7	power supply
8	pneumatic hose with tar filter
9	moisture filter

## 4.2.3 Inside view



**Figure 9:** Inside view Pneumatic Unit

1	electronics board
2	pump
3	pressure sensor (vacuum)
4	main fuse
5	pressure sensor (blow)
6	circuit filter socket
7	thermal conductivity detector
8	valve 1
9	valve 2

See section 4.2.4 for the connections on the bottom of the instrument.

**⚠ DANGER:** The Hydris® pneumatic unit may only be opened by skilled technical personnel with the utmost care. The unit contains dangerous high voltages.

**📄 Note:** The pneumatic unit should never be opened on the shop floor. Always clean first the top of the pneumatic unit before opening it so no dust can fall in.

### 4.2.3.1 Main components

The following describes briefly the main components of the pneumatic unit.

## Pump

The pump is switched on during the probe detection mode to limit the use of nitrogen. Once a pressure of 2500hPa is measured, valve 1 switches and the nitrogen is directly blown through the blow side.

## Valves

The valves are driven by an electromagnetic solenoid, which in turn is driven through the electronics by the processor unit.

## Thermal Conductivity Detector

The thermal conductivity detector (TCD) is a widely used detector for gas chromatography. It monitors the rate of the heat transfer by the carrier gas away from an electrically heated wire. Since the temperature of this wire is directly proportional to its electrical resistance, the rate of heat transfer can be measured by measuring the resistance.

The heated elements are connected electrically in a Wheatstone bridge. A different thermal conductivity results in a change of resistance and a different output of the Wheatstone bridge. The accuracy of the system is due to the high thermal conductivity of hydrogen compared with other gases like nitrogen and argon.

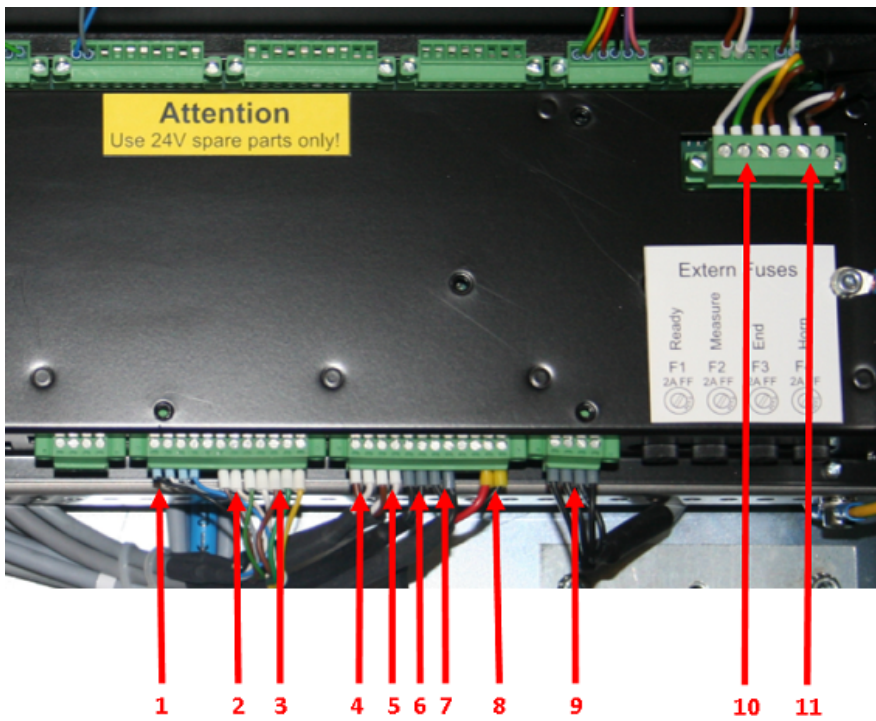
## Moisture Filter

The moisture filter is a very important component of the system. The filter eliminates moisture, oil and dirt, which contaminates the TCD and fouls the pump and valves. It is very important to monitor the life of the filter. This monitoring is done by the processor unit.

When a predetermined number of measurements on the filter has been reached, the processor displays the warning "Replace circuit filter" and the red signal light blinks for five seconds. On changing the filter, the filter counter is set to zero.

The filter is often responsible for a leak in the system. Change the filter once there is a leak. If another leak is detected, check the pump and valves (see 12.1 ).

### 4.2.3.2 Electronics board, Fuses and Loads



**Figure 10:** Overview of contacts for components on the electronics board

<b>1</b>	Moisture sensor (X5: 1-4)
<b>2</b>	Temperature sensor (X5: 6-8)
<b>3</b>	Thermal conductivity detector (X5: 9-12)
<b>4</b>	Pressure sensor Pvac (X6: 1-2)
<b>5</b>	Pressure sensor Pbl (X6: 3-4)
<b>6</b>	Valve 1 Blow (X6: 5-6)
<b>7</b>	Valve 2 Vac (X6: 7-8)
<b>8</b>	Pump (X6: 11 Red, 12: Black)
<b>9</b>	Power 24V (X7: 1-4)
<b>10</b>	Signal lights (X8: 3-6)
<b>11</b>	Horn (X8: 1-2)

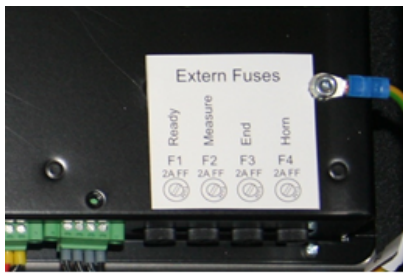


Figure 11: Overview of Extern Fuses inside the pneumatic unit

Table 8: Extern Fuses

Number	Function
F1	Ready Fuse (2A FF 250V)
F2	Measure Fuse (2A FF 250V)
F3	End Fuse (2A FF 250V)
F4	Horn Fuse (2A FF 250V)

**Note:** Maximum external load: 100 W  
 All fuses: 20 mm fine wire fuses

### 4.2.4 In- and outputs Pneumatic Unit

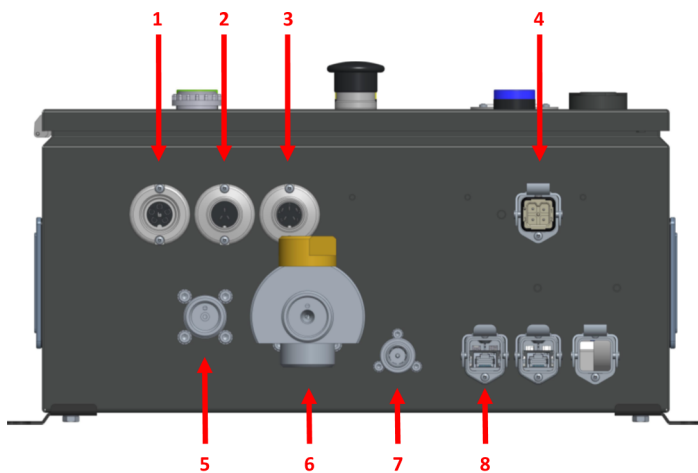


Figure 12: Bottom view Pneumatic Unit

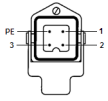
1	start button
2	horn
3	signal lights
4	power supply


5	moisture filter
6	pneumatic hose
7	nitrogen
8	network connection

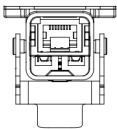
 **Note:** Complete plugs (male and female parts) are delivered with the pneumatic unit.

#### 4.2.4.1 Overview in- and outputs Pneumatic Unit

**Table 9: Overview in- and outputs pneumatic unit**

Name	Connector type	Front view	Wiring scheme		
			Pin	Cable colour	Function
Power supply	Harting HAN 3A-M		1	brown	L
			2	blue	N
			3	-	Not connected
			PE	yellow/green	protective earth

 **Warning:** Always use a power supply cable with protective earth. Minimum rating 250 V, 0.75 mm<sup>2</sup>.

Name	Connector type	Front view	Wiring scheme	
			Pin	1000Base-T
LAN	Harting 3A RJ45		1	BI_DA+
			2	BI_DA-
			3	BI_DB+
			4	BI_DC+
			5	BI_DC-
			6	BI_DB-
			7	BI_DD+
			8	BI_DD-

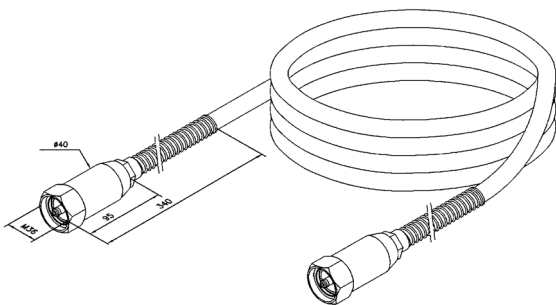
Name	Connector type	Front view	Wiring scheme
Start button	Female socket 5-pin type 09-004-0005		
Horn	Male socket 3-pin type 09-0035-0003		
Signal lights	Male socket 5-pin type 09-0039-0003		

## 4.3 Pneumatic Hose

Characteristics:

- special leak-free assembly
- connects the Hydris® pneumatic system and lance
- standard length: 10m (also available in 5m or 15m on request)

Contact your local Heraeus Electro-Nite representative for the order numbers.



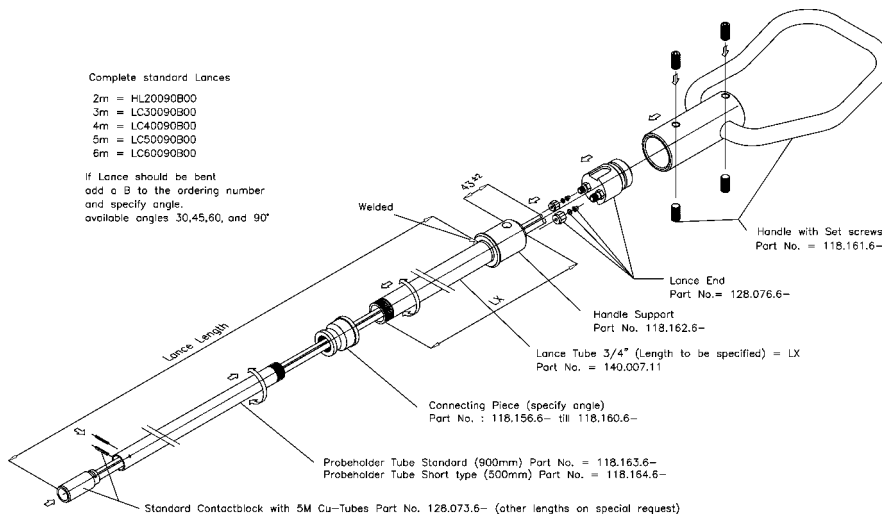
## 4.4 Lance

### Characteristics:

- special leak free assembly, by using connections near the handle, on a remote distance from the heat
- integrated contact block and copper tubes
- lengths from 2m to 6m straight or bended (available angles 30, 45, 60 and 90°).

Contact your local Heraeus Electro-Nite representative for the order numbers.

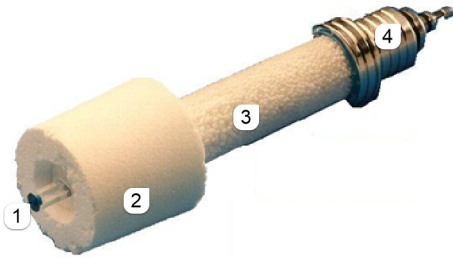
Description of the different parts and assembly of the lance: see 12.4



**Figure 13:** Lance composition

## 4.5 Hydris Probe

The following image shows the Hydris<sup>®</sup> insert before final assembly in a cardboard tube:



1	bubbler tube
2	porous stone
3	quartz tube
4	connector (including O-rings)

The Hydris<sup>®</sup> probe has the following components:

- 1 Bubbler tube: The nitrogen carrier gas is blown through the bubbler tube into the melt.
- 2 Porous stone: The nitrogen carrier gas blown in the melt is recovered through the porous stone.
- 3 Quartz tube: Contains filter material that protects the connector and contact block and collects volatile compounds.
- 4 Connector: The connector with the o-rings provides a firm, gas-tight, push-on/pull-off connection of the probe to the lance.
- 5 Protective caps: These are used to avoid slag penetration into the porous stone. They consist of a paper cap and a steel cap (for ingot probes an aluminium cap is used).
- 6 Refractory sleeve: Consists of a ceramic fibre sleeve for tundish probes and sand protection for the ladle probes.



**CAUTION:** Use only original Heraeus Electro-Nite Hydris<sup>®</sup>-Probes. Otherwise no liability for incorrect measurements or malfunctions can be accepted.

## 5. User Interface Design

### 5.1 User Interface

The user interface consists of two components, the pneumatic unit and the processor unit.



**Figure 14:** Main user interface Pneumatic Unit

1	signal lights displaying the measurement status
2	manometer
3	measurement start button
4	acoustic signal (horn)
5	display of the result.

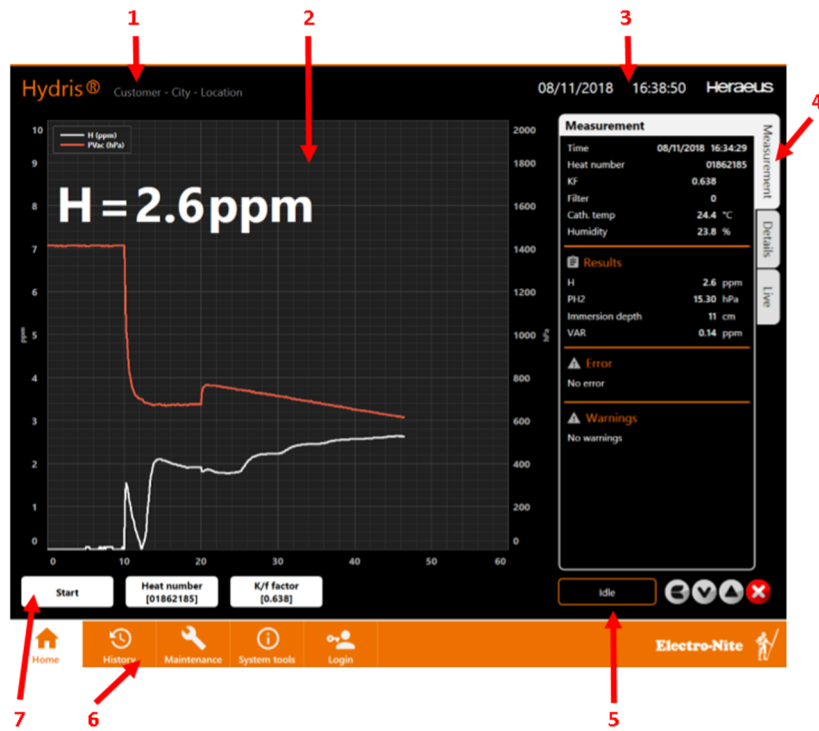


Figure 15: Main user interface Processor Unit

1	customer information (customer, city, location)
2	chart area
3	current date and time
4	measurement tabs (measurement, details, live)
5	measurement status
6	navigation buttons (home, history, maintenance, settings, system tools, login)
7	measurement buttons (start, heat number, K/f factor)

## 5.2 User inputs and outputs

### 5.2.1 Pneumatic Unit

The following table gives an overview of the operator actions and signalisation on the pneumatic unit and the corresponding status of the measurement.





**Table 10: Overview measurement status on pneumatic unit**

At this signal on the pneumatic unit ...	You...	And the Hydris® system...	The Pneumatic Unit Display Shows...
Red	Push the start button on the pneumatic unit to start a measurement.	Is in idle mode.	Empty or last result
Red + Yellow	Push a probe on to the probe holder.		
Yellow + Green	Wait.	Sets the system to zero and cleans its gas circuit to avoid the influence of waste gases.	-O-
Green	Take the lance and immerse the probe in to the steel melt.	Is ready to measure.	run
Yellow	Keep the probe immersed.	Measures the hydrogen content.	Seconds counter
Red	Remove the lance from the steel bath and the probe from the lance.	Stops the hydrogen measurement. The system is flushed for 20 seconds and is put in idle mode. A new measurement sequence can now be started.	Result

### 5.2.2 Processor Unit

The following table gives an overview of the operator actions and signalisation on the processor unit and the corresponding status of the measurement.

**Table 11: Overview measurement status on processor unit**

At this signal on the pneumatic unit ...	You...	And the Hydris® system...
	Push the start button to start a measurement.	Is in idle mode.
	Wait.	Sets the system to zero and cleans its gas circuit to avoid the influence of waste gases.
	Take the lance and immerse the probe in to the steel melt.	Is ready to measure.
	Remove the lance from the steel bath and the probe from the lance.	Stops the hydrogen measurement. The system is purged for 20 seconds and is put in idle mode. A new measurement sequence can now be started.

## 5.3 User levels

There are multiple user levels which enable different access to the machine:

- operator (no password)
- engineer, supervisor, lab technician (2-4-4-8)
- service engineer (day password provided by your local Heraeus Electro-Nite contact)

To enter the supervisor or engineer interface login is required.

- 1 Click the **Login** button on the navigation bar
- 2 Login screen pops-up

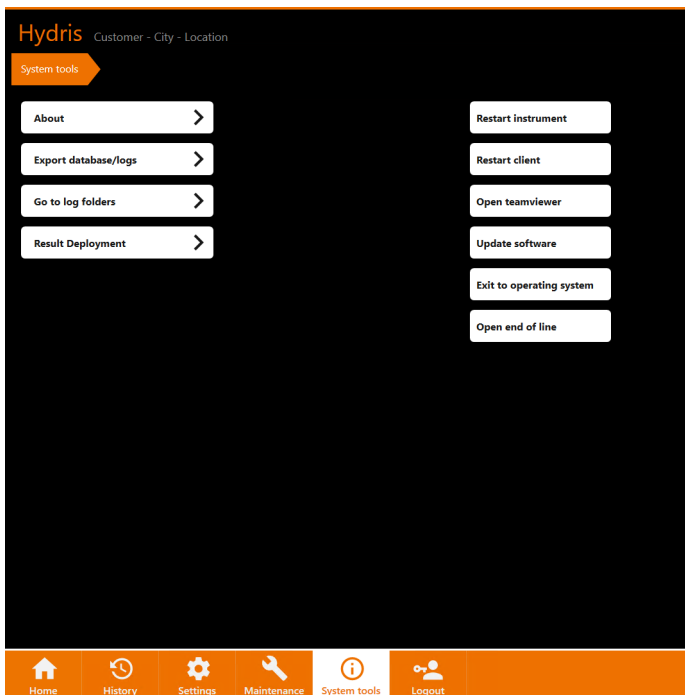


- 3 Enter the password and then click **Go**
- 4 Extra button(s) will appear on the navigation bar



**Note:** After a preset time without activity the system will automatically logout.

## 5.4 System tools



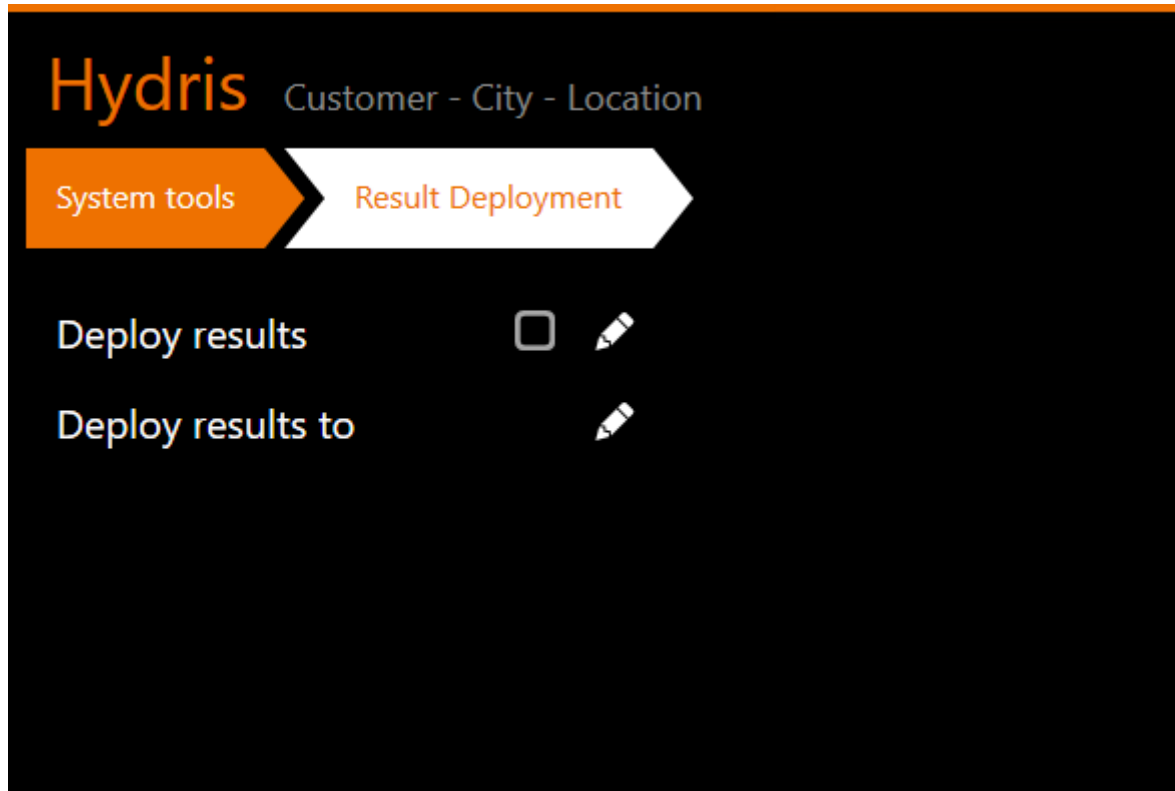
**Figure 16:** System tools screen

In system tools you can find more information **About** the system, e.g. software release installed.

After login with the engineer password extra functionalities are unlocked such as:

- Export database/logs: to export the database and/or the log files
- Restart instrument: to restart the instrument
- Open teamviewer: for remote assistance
- Result Deployment: to export results in .pdf format to an external location

To configure the result deployment click on the result deployment button. The next screen will pop up:



To enable the 'deploy results' setting, click the pencil.

To configure where to 'deploy results to' also click the pencil and type where to deploy the results to e.g. X:\resultdeploy\.

## 6. Installation

### 6.1 System requirements

#### Power requirements:

---

Processor unit: 100-240VAC, 50-60Hz, 1.6-0.9A

---

Pneumatic unit: 100-240VAC, 50-60Hz, 62VA max

---

#### Gas requirements:

---

Nitrogen gas bottle or nitrogen plant line (bottle preferred)

---

Purity of nitrogen gas	Nitrogen 5.0 (at least 99.999% pure) No hydrogen residue Dry and clean (H <sub>2</sub> O ≤ 5ppm)
------------------------	--

---

Pressure regulation	Gas inlet pressure between 5 to 8 Bar
---------------------	---------------------------------------

---

 **Note:** use leak-free pressure regulators

---

Gas consumption	200 measurements with a 2m <sup>3</sup> nitrogen bottle depending on flushing and measurement times
-----------------	---

---

**!** **Warning:** Check regularly for leakage of nitrogen. Leakage of nitrogen can displace the oxygen in the air in an almost closed environment. This can result in a dangerous situation for the operator.

### 6.2 Where to install the system

The pneumatic unit should be installed no further than 10m from the operating floor and should be hung vertically with M8 bolts.

**!** **Warning:** Please make sure that the Hydris<sup>®</sup> processor and pneumatic units are mounted on a safe and accessible position to enable safe operation. Decoupling the power of the instrument should always happen on a secure and accessible location.

## 6.3 Starting up the system

1 Ensure all connections are correctly made (see section 4.2.4 and 4.1.2 ).

2 Connect the power cable of the pneumatic unit to the mains power.

3 Switch on the processor unit and panel PC.

The processor and pneumatic are configured so that they automatically connect to each other at start up.



**Note:** Communication with the processor is guaranteed starting from version 0.027.

4 Connect to the processor unit remotely (see section 6.4 ).

5 Check if the filter is present.

6 Perform an air test ( 11.5 ).

7 Perform a leakage test ( 11.6 ).

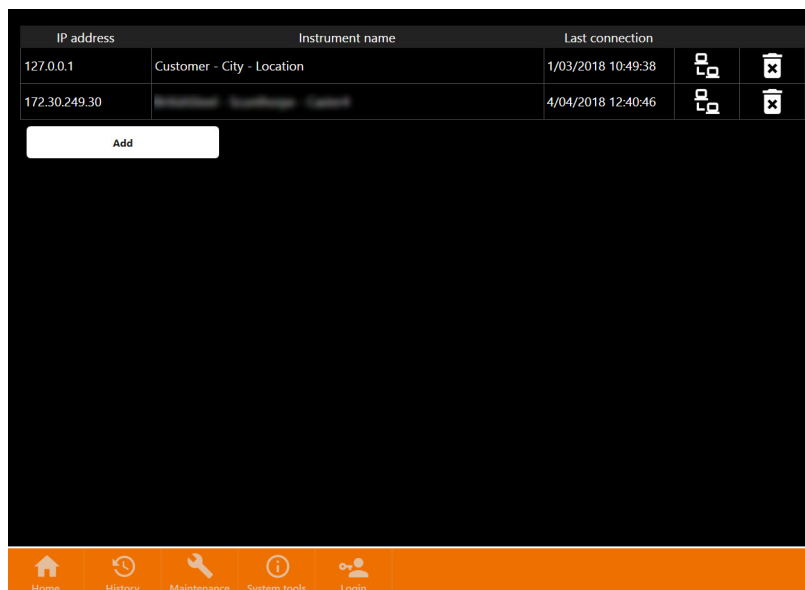
8 The system is ready for measurement.



**Note:** If the ambient temperature is below 5°C, wait for 30 minutes before carrying out a measurement to allow the instrument to obtain ideal working temperatures.

## 6.4 Connect to the processor unit remotely

When starting up the processor unit from a remote PC, the following screen is displayed.



1 Click **Add** to add a new connection to the instrument.

2 Click to connect to the instrument.

3 Click to remove an existing connection to the instrument.

# 7. Operation

## 7.1 Operator screen

The main operations can be controlled from the home screen.

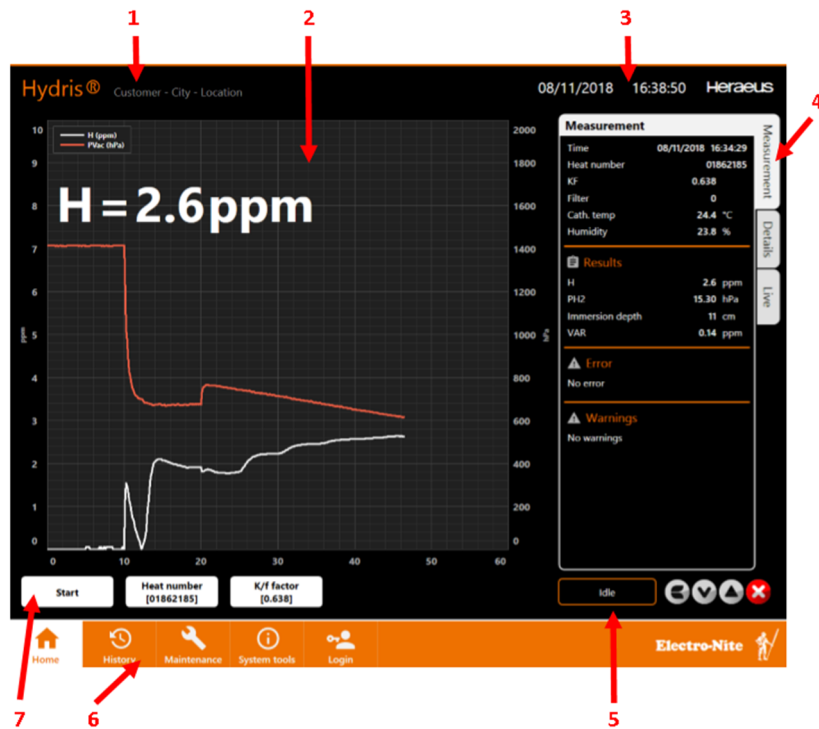
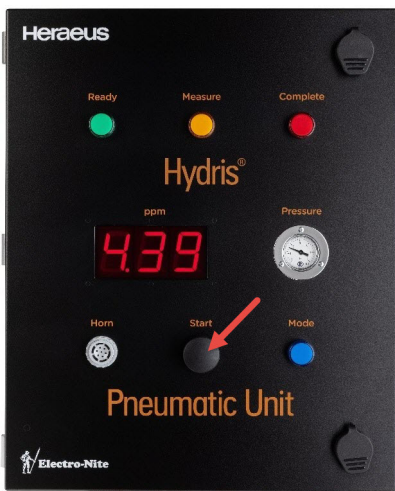
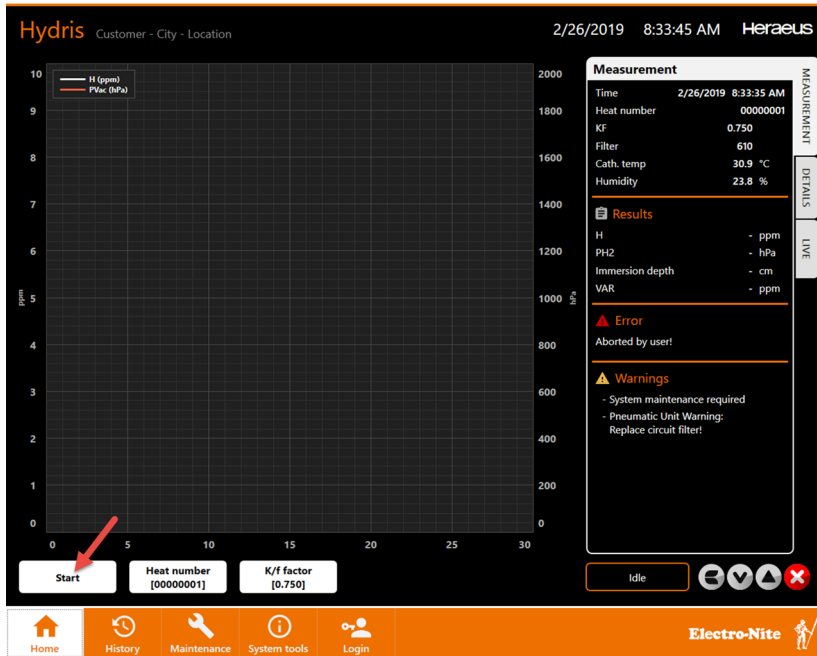


Figure 17: Operator screen

#	Name	Function	Details in §
1	customer information	information about the location	8.2.2
2	chart area	shows the curve and the result of the latest measurement	7.3.2
3	date and time	shows current date and time	8.2.1
4	measurement tabs	extra measurement information	
5	measurement status	information measurement status	5.2
6	navigation buttons	navigate between the different operator screens	
7	measurement buttons	start the measurement or change the heat number or K/f factor	7.2

## 7.2 Performing a measurement

Push the **Start** button on the front of the pneumatic unit to start the measurement or push the **Start** button in the home screen of the processor unit.



**CAUTION:** the pneumatic unit buzzer produces noise with a strength higher than 80 dB for more than 3 seconds. Hearing protection must be worn when using the instrument.

## 7.2.1 Dipping the Probe Correctly

To provide accurate results, Hydris® contains fragile components. For this reason, place the sensor on the probe holder and dip it more carefully than normal temperature sensors.

- 1 Push the sensor firmly on to the probe holder. Do not ram it.
- 2 Dip only through fluid steel or slag. Do not try to break through crusting slags. Otherwise, you could burn out the end and break the bend of the lance.
- 3 Immerse the sensor between a third and two thirds of the length of the non-splash sleeve. Do not immerse above the top of the non-splash sleeve. Otherwise, you could burn the probe holder.
- 4 Dip away from argon bubbling. Otherwise, you could get inaccurate results.
- 5 Dip the sensor as vertically as possible, certainly not more than 30 degrees from the vertical. Otherwise, you could get inaccurate results.

### 7.2.1.1 Correction of Partial Pressure

The immersion depth slightly affects the hydrogen measurement. This is because the partial pressure of hydrogen as measured by the system is the result of the measurement of the hydrogen content in the carrier gas (analysed as %) in combination with the total pressure at the point of measurement.

The total pressure measured at the point of measurement increases with increasing immersion depth as the ferrostatic pressure of the steel should be added to the atmospheric pressure.

#### Example:

The total pressure at 25 cm depth of steel and 5 cm of slag is calculated by the following formula (where  $P_{at}$  is an atmospheric pressure of around 1013 hPa):

$$P = P_{at} + 3.04 * (\text{cm slag thickness}) + 6.95 * (\text{cm steel depth})$$

$$\text{Result: } P = 1013 + 3.04 * 5 + 6.95 * 25 = 1219 \text{ hPa}$$

If a hydrogen content of 5% is measured, this results in a partial pressure of 50 hPa at 0 cm immersion depth (5% of 1000 = 50 hPa). This same hydrogen content of 5% at an immersion depth of 25 cm, however, results in a higher partial pressure: 66 hPa (5% of 1219 = 66hPa). consequently the correct hydrogen content can be calculated as follows:

$$\text{ppm } H_{\text{corr}} = \text{ppm } H_{0\text{cm}} * \sqrt{(1 + 3.04 * \text{Slag thickness}/P_{at} + 6.95 * \text{steel depth}/P_{at})}$$

Where ppm  $H_{0\text{cm}}$  is the measured value with an immersion depth of 0 cm selected in the parameter list.

The following table shows the influence in % on the measured value, by comparing different immersion depths to a pre-selected immersion depth of 25 cm. As immersion depths only vary due to practical limitations between 20 and 40 cm, the difference remains limited to maximum 5%. The influence of slag is only a few % and can be ignored.

**Table 12: Influence of immersion depth and thickness of slag on the hydrogen content measured**

Thickness slag (cm)	Immersion depth							
	15	20	25	30	35	40	45	50
2	-3.0	-1.5	0.0	1.4	2.9	4.3	5.7	7.0
4	-2.7	-1.2	0.2	1.7	3.1	4.5	5.9	7.3
6	-2.4	-1.0	0.5	1.9	3.4	4.8	6.1	7.5
8	-2.2	-0.7	0.8	2.2	3.6	5.0	6.4	7.7
10	-1.9	-0.4	1.0	2.4	3.9	5.2	6.6	8.0
12	-1.7	-0.2	1.3	2.7	4.1	5.5	6.9	8.2

**Table 12: Influence of immersion depth and thickness of slag on the hydrogen content measured**

Thickness slag (cm)	Immersion depth							
	15	20	25	30	35	40	45	50
14	-1.4	0.1	1.5	2.9	4.3	5.7	7.1	8.4
16	-1.1	0.3	1.8	3.2	4.6	6.0	7.3	8.7
18	-0.9	0.6	2.0	3.4	4.8	6.2	7.6	8.9
20	-0.6	0.8	2.3	3.7	5.1	6.4	7.8	9.1

When set to automatic, the system automatically determines the immersion depth during each measurement. The hydrogen ppm level is recalculated accordingly.

## 7.2.2 Measurement Procedure

Once a measurement has been started, the following messages are displayed on the display of the pneumatic unit and on the status bar on the home screen of the processor unit:

**Table 13: Display of messages during the measurement**

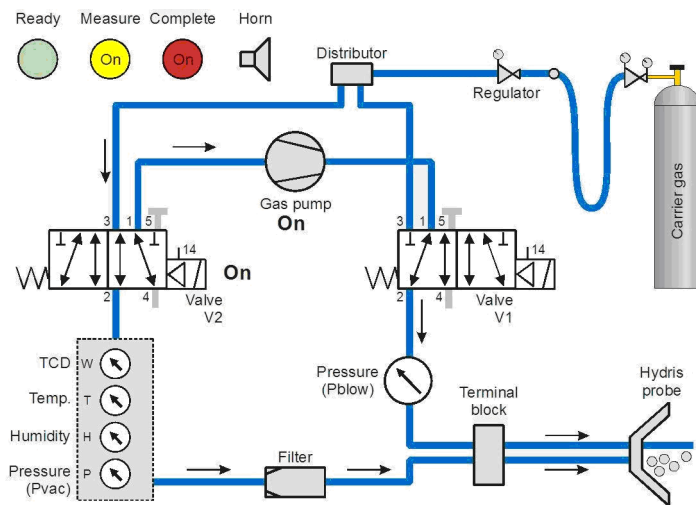
Phases	Processor unit	Pneumatic unit
Before immersion	Idle	-P-
	Probe detection	-P-
	Zero setting	-0-
	Ready to measure	run
During immersion	Flush period A	seconds counter
	Flush period B	seconds counter
	Equilibrium measurement	seconds counter
	Purging	result

Understanding the Hydris<sup>®</sup> measurement procedure is essential to help you quickly resolve problems and avoid unnecessary actions being performed.

The following schematics and tables contain detailed explanations of all the steps in a measurement. These steps are used:

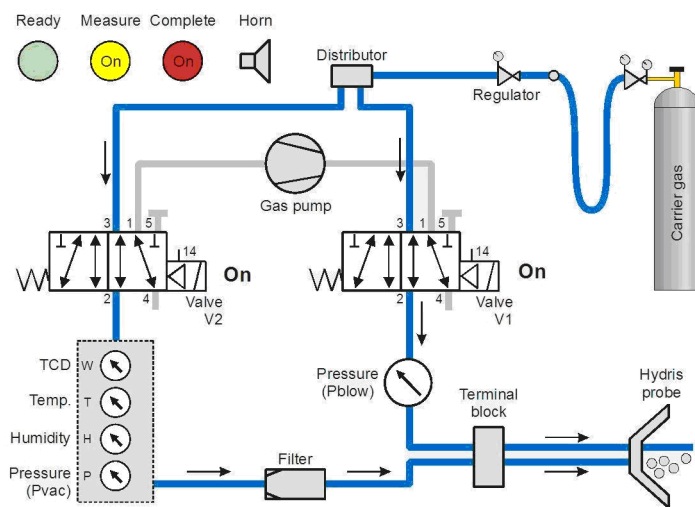
- carrier gas blow circuit: Part of the circuit between the pump (over the valve on the blow side) and the bubbler tube of the probe.
- carrier gas vacuum circuit: Part of the circuit between the porous stone (over the filter and TCD) and the valve on the vacuum side.

### 7.2.2.1 Attach probe to probe holder



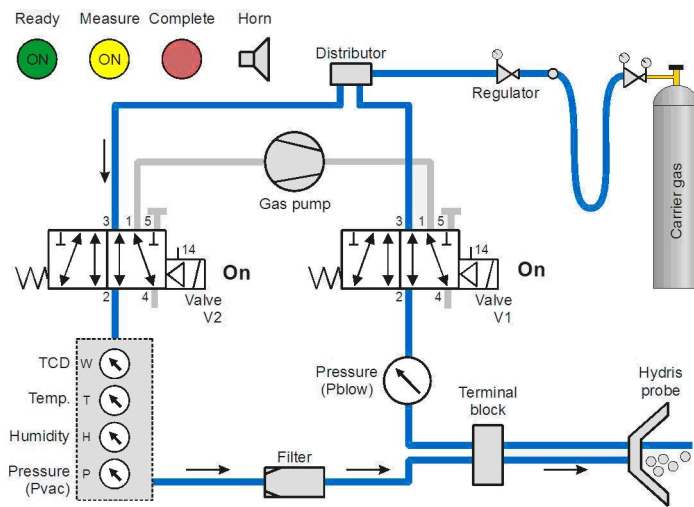
Unit	State
Processor unit	Probe detection
Pneumatic unit	yellow and red lights on
Carrier gas blow circuit	Air is blown through the circuit
Carrier gas vacuum circuit	A small nitrogen flow is blown through the circuit
Gas in the TCD	Nitrogen
End of this step	Pblow>2500hPa
Next step	Gas pressure too low or zero setting
Pump	Activated
Valve vacuum circuit	Activated
Valve blow circuit	Off

### 7.2.2.2 Gas pressure too low



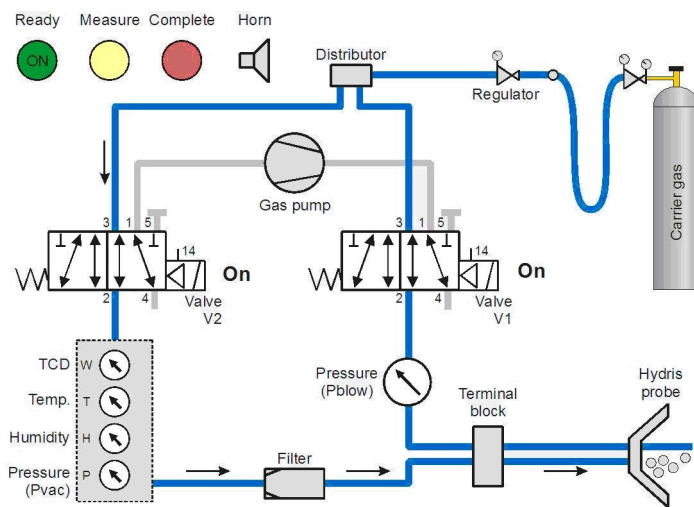
Unit	State
Processor unit	gas pressure too low
Pneumatic unit	yellow and red lights on
Carrier gas blow circuit	nitrogen is blown through the circuit
Carrier gas vacuum circuit	A small nitrogen flow is blown through the circuit
Gas in the TCD	Nitrogen
End of this step	Pblow>4500hPa
Next step	zero setting
Pump	off
Valve vacuum circuit	Activated
Valve blow circuit	Activated

### 7.2.2.3 Zero setting



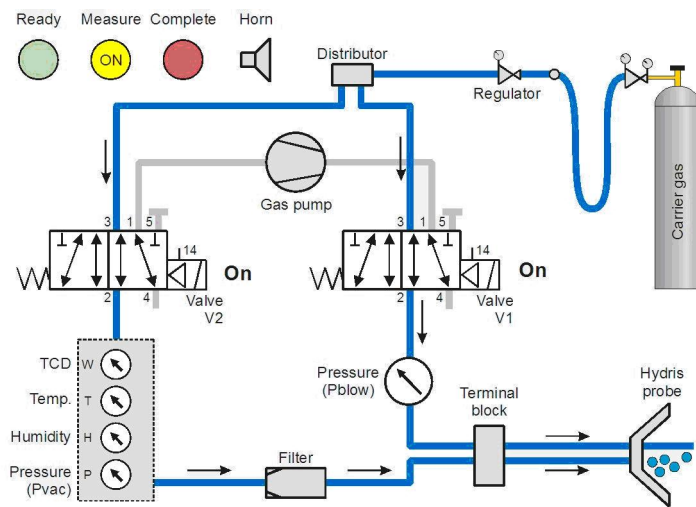
Unit	State
Processor unit	zero setting
Pneumatic unit	green and yellow lights on
Carrier gas blow circuit	Nitrogen pressure of 4500 is in the circuit. There is no circulation as the bubbler tube is blocked.
Carrier gas vacuum circuit	A small nitrogen flow is blown through the circuit
Gas in the TCD	Nitrogen
End of this step	TCD zero setting
Next step	ready to measure
Pump	off
Valve vacuum circuit	Activated
Valve blow circuit	Activated

### 7.2.2.4 Ready to measure



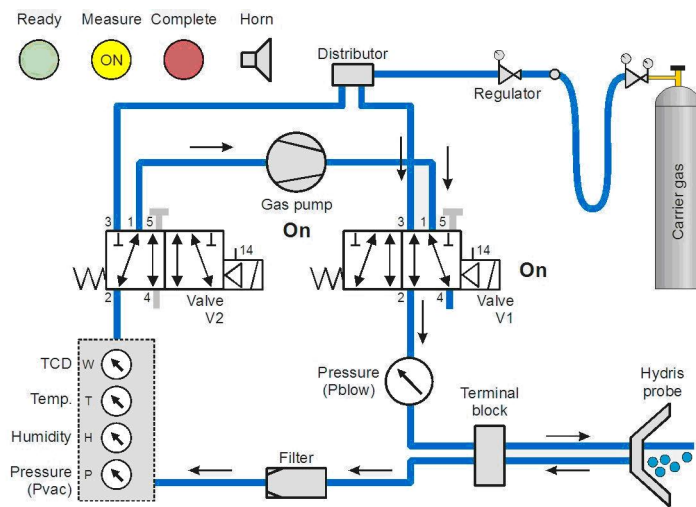
Unit	State
Processor unit	ready to measure
Pneumatic unit	green light on
Carrier gas blow circuit	Nitrogen pressure of 4500 is in the circuit. There is no circulation as the bubbler tube is blocked.
Carrier gas vacuum circuit	A small nitrogen flow is blown through the circuit
Gas in the TCD	Nitrogen
End of this step	Pblow <4500hPa
Next step	flush A
Pump	off
Valve vacuum circuit	Activated
Valve blow circuit	Activated

### 7.2.2.5 Flush A



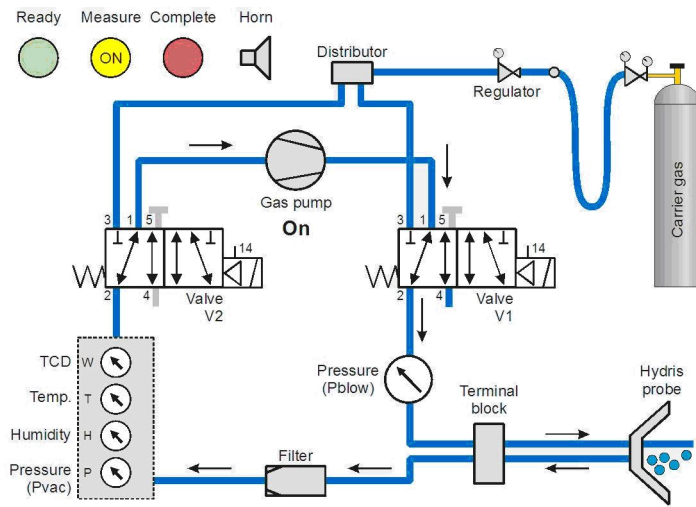
Unit	State
Processor unit	flush A
Pneumatic unit	yellow light on
Carrier gas blow circuit	The bubbler tube opens and the nitrogen is blown into the steel.
Carrier gas vacuum circuit	A small nitrogen flow is blown through the circuit and through the porous stone to clean the probe.
Gas in the TCD	Nitrogen
End of this step	When the selected time of flush A (parameter list) has been exceeded.
Next step	flush B
Pump	off
Valve vacuum circuit	Activated
Valve blow circuit	Activated

### 7.2.2.6 Flush B



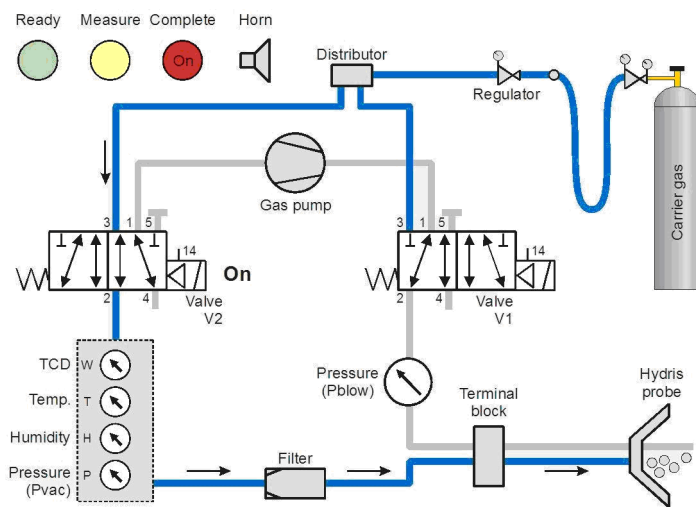
Unit	State
Processor unit	flush B
Pneumatic unit	yellow light on
Carrier gas blow circuit	Nitrogen is blown into the steel.
Carrier gas vacuum circuit	The nitrogen carrier gas is recovered, containing some hydrogen, but is not recirculated into the melt.
Gas in the TCD	Nitrogen and hydrogen
End of this step	When the selected time of flush B (parameter list) has been exceeded.
Next step	equilibrium measurement
Pump	activated
Valve vacuum circuit	off
Valve blow circuit	activated

### 7.2.2.7 Equilibrium measurement



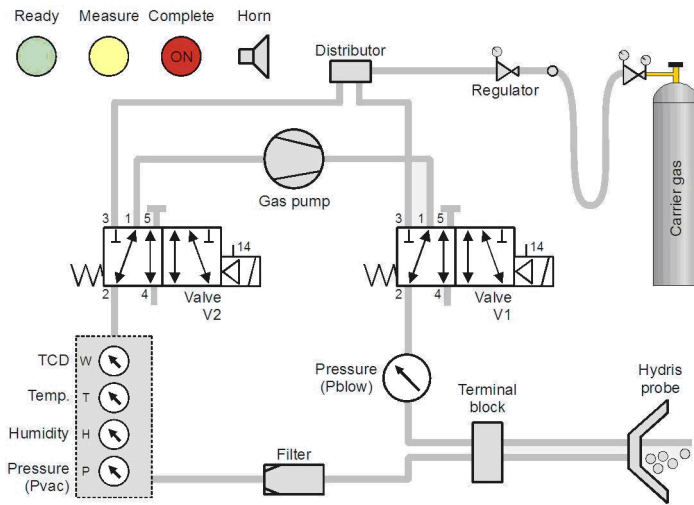
Unit	State
Processor unit	measuring
Pneumatic unit	yellow light on
Carrier gas blow circuit	The nitrogen carrier gas containing some hydrogen is recirculated through the blow tube in the steel melt.
Carrier gas vacuum circuit	The nitrogen carrier gas is recovered from the steel melt, absorbing hydrogen until equilibrium is obtained.
Gas in the TCD	Nitrogen and hydrogen
End of this step	Var < Window height preset by selecting parameter A and B.
Next step	end of measurement
Pump	activated
Valve vacuum circuit	off
Valve blow circuit	off

### 7.2.2.8 End of measurement



Unit	State
Processor unit	purging
Pneumatic unit	red light on
Carrier gas blow circuit	The circulation of gas is stopped.
Carrier gas vacuum circuit	A small nitrogen flow is blown through the system to clean the circuit.
Gas in the TCD	Nitrogen
End of this step	after purging
Next step	standby
Pump	off
Valve vacuum circuit	activated
Valve blow circuit	off

### 7.2.2.9 Standby



Unit	State
Processor unit	idle
Pneumatic unit	red light on
Carrier gas blow circuit	no gas
Carrier gas vacuum circuit	no gas
Gas in the TCD	no gas
End of this step	
Next step	start of a new measurement
Pump	off
Valve vacuum circuit	off
Valve blow circuit	off

### 7.2.2.10 Summary of the measurement procedure

The following table shows a summary of the measurement procedure automatically performed by Hydris®.

**Table 14: Summary of the measurement procedure**

Processor unit	Pneumatic unit	Valve vacuum side	Valve blow side	Pump	Pressure vacuum	Pressure blow	gas in TCD
Idle	Red	Off	Off	Off			
Detect probe	Red + Yellow	On	Off	On	1100	<2500	Nitrogen
Gas pressure too low	Red + Yellow	On	On	Off	1100	<4500	Nitrogen
Zero setting	Yellow + Green	On	On	Off	1100	>4500	Nitrogen
Ready to measure	Green	On	On	Off	1100	>4500	Nitrogen
Flush period A	Yellow	On	On	Off	1100	2400	Nitrogen
Flush period B	Yellow	Off	On	On	800	2400	Nitrogen + hydrogen
Equilibrium measurement	Yellow	Off	Off	On	750 <sup>1</sup>	1700 <sup>2</sup>	Nitrogen + hydrogen
Purging	Red	On	Off	Off			Nitrogen
Standby	Red	Off	Off	Off	Atmospheric pressure	Atmospheric pressure	

1 Indicative value

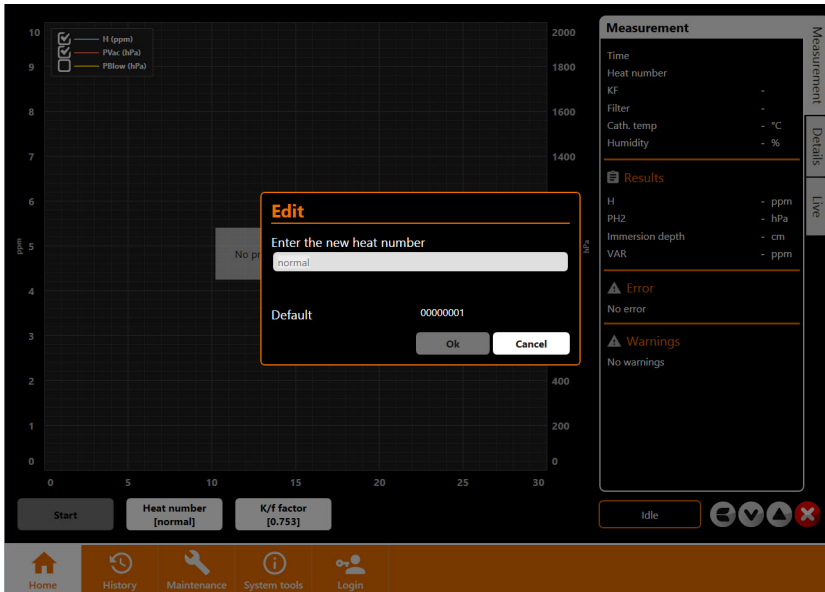
2 Indicative value

### 7.2.3 Entering the heat number

Before measuring, you can enter the heat number of the ladle. The new heat number is immediately displayed.

- 1 Press the **Heat number** button on the home screen.

The next screen pops-up:



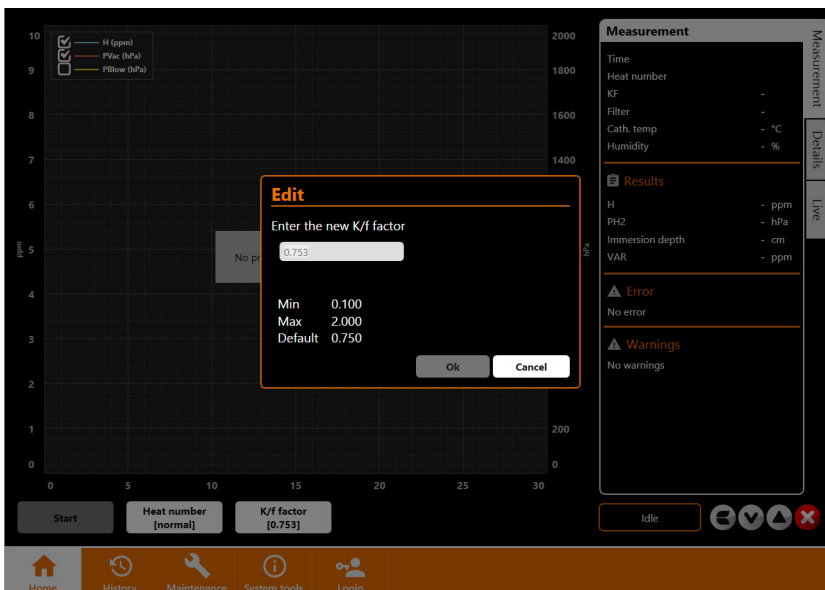
- 2 Enter the new heat number
- 3 Click **Ok**

### 7.2.4 Entering the K/f value

You can enter a K/f value, before measurement, on the home screen of the processor unit or send it through level 2 communication.

- 1 Click the **K/f factor** button on the home screen.

The next screen pops-up:

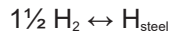


- 2 Enter the new K/f factor
- 3 Press **Ok**

### 7.2.4.1 Calculation of the K/f factor

The K/f factor can be calculated based on the solubility of Hydrogen in liquid steel.

The dissolution reaction of gaseous hydrogen in liquid steel:



is described by the equilibrium constant at a certain temperature.

$$2K_{\text{H}}(T) = a_{\text{H}} / (P_{\text{H}_2})^{1/2}$$

This can also be written as a function of the hydrogen concentration if an interaction parameter for alloying elements is introduced.

$$3K_{\text{H}}(T) / f_{\text{H}} = [\% \text{H}] / (P_{\text{H}_2})^{1/2}$$

Data of  $K_{\text{H}}(T)$  and  $f_{\text{H}}$  can be found.  $K_{\text{H}}(T)$  satisfies the condition:

$$4 \log K_{\text{H}}(T) = -1900/T + 0.9201$$

and for the most important alloying elements C, Cr, Mn, Nb, Ni, Si, and Ti  $f_{\text{H}}$  is given by:

$$5 \log f_{\text{H}} = 0.06 [\% \text{C}] - 0.0022 [\% \text{Cr}] - 0.0014 [\% \text{Mn}] - 0.0023 [\% \text{Nb}] - 0.0016 [\% \text{Ni}] + 0.023 [\% \text{Si}] - 0.019 [\% \text{Ti}] + 0.0022 [\% \text{Mo}] - 0.0074 [\% \text{V}] + 0.0018 [\% \text{Co}]$$

#### Conclusion:

Hydris<sup>®</sup> measures the partial pressure of hydrogen in the steel melt. This partial pressure is converted into hydrogen content of the steel according to Sievert's law,

$$H = K / f * \sqrt{P_{\text{H}_2}}$$

where:

- H = hydrogen content of the steel in ppm
- $K_{\text{H}}$  = equilibrium constant of the reaction  $\text{H}_2 \leftrightarrow 2 \text{H}$
- $f_{\text{H}}$  = hydrogen activity coefficient
- $P_{\text{H}_2}$  = partial pressure of hydrogen in the melt

#### Short thermodynamic description:

$K_{\text{H}}$  = depends only on temperature, however the influence of temperature is relatively small

$f_{\text{H}}$  = influences the alloying elements on the solubility of hydrogen in liquid steel.

The most important elements are carbon and silicon.

#### Thermodynamic data

The following tables give also a quick and accurate calculation of the K/f factor based on thermodynamic data. The first table simplifies the calculation by reducing all elements present in the steel to one element, that is, the carbon equivalent. The carbon content is calculated for each element showing the effect on the interaction parameter. The second table shows the effect of carbon (equivalent) and the temperature on the K/f factor.

Carbon equivalent of alloying elements

Element	Carbon equivalent for 1%	Element in % (examples)	Ceq (examples)
C	1		
Si	0.38	0.1 0.3 0.5	0.038 0.114 0.19
Cr	-0.037	0.5	-0.018
Mn	-0.023	0.5 1 1.5	-0.011 -0.023 -0.035
Mo	0.036	0.5 1.5	0.018 0.036
Ni	-0.028	0.5 1.5 Other:	-0.013 -0.04
S	0.133	0.03	0.004
P	0.216	0.03	0.005
Al	0.05	0.5	0.002
B	0.083	0.03	0.002
Co	0.03	1.5	0.045
V	-0.123	0.1	-0.012
Ti	0.318	0.04	0.013
W	0.08	0.5	0.04

#### Effect of carbon equivalent (Ceq) and the temperature on the K/f factor

Temp/ Ceq	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
1510	0.705	0.696	0.686	0.677	0.668	0.658	0.649	0.640	0.632	0.623
1520	0.715	0.705	0.696	0.686	0.677	0.667	0.658	0.649	0.640	0.632
1530	0.725	0.715	0.705	0.696	0.686	0.677	0.667	0.658	0.649	0.640
1540	0.735	0.725	0.715	0.705	0.695	0.686	0.676	0.667	0.658	0.649
1550	0.744	0.734	0.724	0.714	0.704	0.695	0.685	0.676	0.667	0.657
1560	0.754	0.744	0.734	0.724	0.714	0.704	0.694	0.685	0.675	0.666
1570	0.764	0.754	0.743	0.733	0.723	0.713	0.703	0.694	0.684	0.675
1580	0.774	0.763	0.753	0.743	0.732	0.722	0.712	0.703	0.693	0.683
1590	0.784	0.773	0.762	0.752	0.742	0.732	0.722	0.712	0.702	0.692
1600	0.794	0.783	0.772	0.762	0.751	0.741	0.731	0.721	0.711	0.701
1610	0.804	0.793	0.782	0.771	0.760	0.750	0.740	0.730	0.720	0.710
1620	0.814	0.802	0.791	0.781	0.770	0.759	0.749	0.739	0.728	0.718
1630	0.824	0.812	0.801	0.790	0.779	0.769	0.758	0.748	0.737	0.727

Temp/ Ceq	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
1640	0.833	0.822	0.811	0.800	0.789	0.778	0.767	0.757	0.746	0.736
1650	0.843	0.832	0.820	0.809	0.798	0.787	0.776	0.766	0.755	0.745
1660	0.853	0.842	0.830	0.819	0.808	0.796	0.786	0.775	0.764	0.754
1670	0.863	0.852	0.840	0.828	0.817	0.806	0.795	0.784	0.773	0.762

Effect of carbon equivalent (Ceq) and the temperature on the K/f factor in stainless steel

Temp/Ceq	-0.5	-0.4	-0.3	-0.2	-0.1
1490	0.745	0.735	0.725	0.715	0.705
1510	0.766	0.756	0.746	0.735	0.725
1530	0.788	0.777	0.766	0.756	0.745
1550	0.809	0.798	0.787	0.776	0.765
1570	0.830	0.819	0.808	0.796	0.786
1590	0.852	0.840	0.828	0.817	0.806
1610	0.873	0.861	0.849	0.838	0.826
1630	0.895	0.882	0.870	0.858	0.847

## 7.3 Evaluating the results

### 7.3.1 During the measurement

During the measurement the live tab on the right side of the home screen of the processor unit shows the live curve details.

**Table 15: Description of measurement result: live tab**

Name	Example	Description
Humidity	23.8 %	The relative humidity of the carrier gas of each sample during the measurement
Cath. temp	33.3 °C	Temperature of the catharometer of each sample during the measurement
Pvac	593.6 hPa	Pressure in the vacuum circuit as measured by the pressure sensor in the pneumatic unit.
Pblow	1349.8 hPa	Blow pressure as measured by the pressure sensor in the pneumatic unit.
PH2	26.27 hPa	Partial pressure of hydrogen as measured by the system.
VAR		Variation of the hydrogen in ppm during the last 10 seconds (standard window length).
H	4.0 ppm	Measured hydrogen content

The curve is drawn live in the graph area. The distinct steps of the measurement procedure can be clearly seen on the graph:

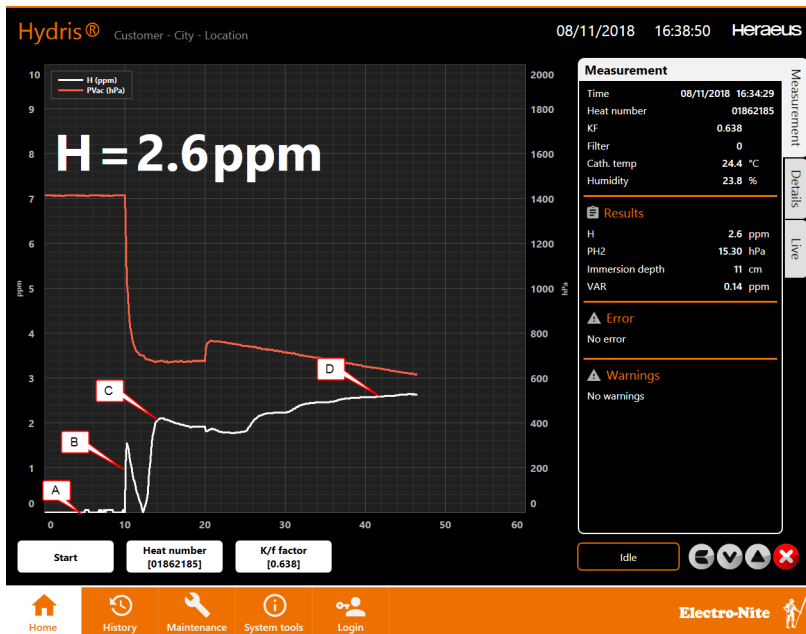


Figure 18: Consequent measurement procedure steps indicated in the graph

#	Measurement step	Activity	Gas in TCD - Pvac
A	Flush period A	Nitrogen is blown throughout the TCD into the melt. The curve is on or very close to the X-axis .	Nitrogen in the TCD. Vacuum pressure is higher than 1150hPa.
B	Flush period B	Typical peak due to sudden pressure change as: a. Pump is activated b. Valve vacuum side is switched.	Nitrogen and hydrogen. Vacuum pressure drops below 900hPa.
C	Flush period B	Hydrogen is absorbed by the nitrogen carrier gas. The curve starts to indicate a hydrogen level .	Hydrogen and nitrogen. Vacuum pressure remains below 900hPa.
D	Measuring	Hydrogen value during measurement .	Hydrogen and nitrogen Pvac drops slowly.

### 7.3.2 Measurement final result

When the measurement is finished, the measured hydrogen concentration is shown on the display of the pneumatic unit. On the the home screen of the processor unit, the result graph is shown and also the hydrogen content.

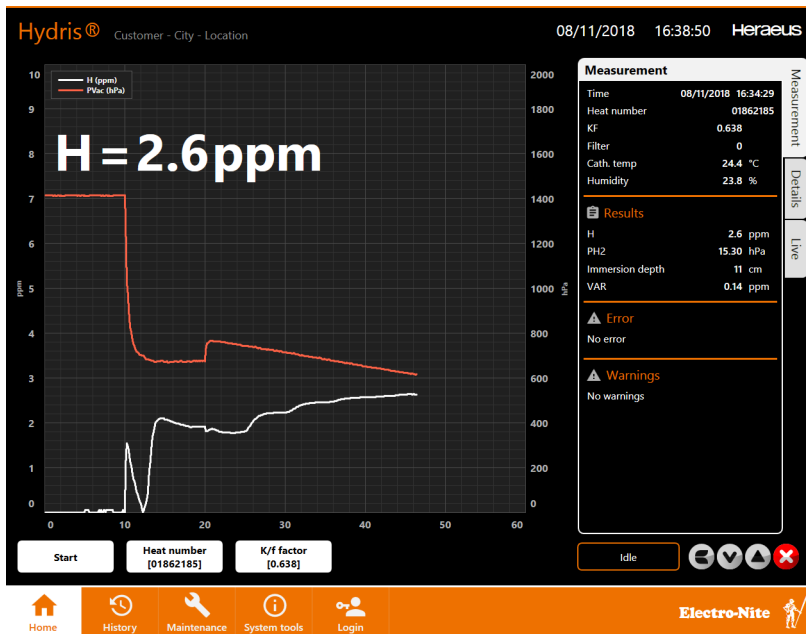


Figure 19: Typic result graph

Chart elements

- Hydrogen content in ppm (Y1-axis)
- Time in seconds (X-axis)
- Hydris® measurement value
- Hydrogen curve in white
- Vacuum pressure (Y2-axis)
- Vacuum pressure curve in red

On the measurement tab on the right side of the screen, more information about the latest measurement is shown in the results section .

Table 16: Description of measurement result: measurement tab

Name	Example	Description
<b>Measurement header</b>		
Time		Shows the date and time of the last started measurement
Heat number		The heat number of the last started measurement
KF	0.75	Is not a measured value, but a value calculated using Sievert's law.
Filter	7	The filter count that indicates how many measurements have been performed with the installed humidity filter on the pneumatic unit
Cath. temp		Temperature of the catharometer
Humidity		The relative humidity of the carrier gas used in the last measurement
<b>Results found at the end of the measurement</b>		

**Table 16: Description of measurement result: measurement tab**

Name	Example	Description
H	2.6 ppm	Measured hydrogen content.
PH2	4.84 hPa	Partial pressure of hydrogen as measured by the system.
Immersion depth	11 cm	The immersion depth of the probe. Depends on a parameter in the instrument. If a fixed immersion depth is used, this value will be used in this variable. If the immersion depth is being evaluated, the evaluated value will be used in this variable.
VAR	0.03 ppm	Variation of the hydrogen in ppm during the last 10 seconds (standard window length).

All details of the latest measurement can be found in the details tab.

**Table 17: Description of measurement result: details tab**

Name	Example	Description
<b>Immersion depth correction values (IDC)</b>		
Air pressure	1085.4 hPa	
Zero setting	1321.9 hPa	
Flush A	1366.6 hPa	
<b>Zero setting</b>		
Zero offset	291.73 hPa	
Cath.temp	26.9 °C	
Humidity	12.2 %	
<b>Auto drift</b>		
Time lag	7.5 s	
Zero offset	291.40 hPa	
Cath. temp		
Humidity		

### 7.3.2.1 Characteristics of Good Measurement Curves

- For hydrogen levels above 2ppm: the curve continuously increases. The slope of the curve should, however, continuously decrease in time.
- For hydrogen levels below 2ppm: the curve has only a small tendency to increase or to remain stable during the measurement time (for values around 1ppm).
- When a short flush A period is used, a decreasing curve is also possible.
- The value at the end of flush B period (unless an important 'nose' is found) is related to the final hydrogen content. A value during flush B of 4 might not correspond to a final value of 5ppm. (The final value should be 7ppm instead of 5.)

**Table 18: Correlation between Hydrogen content during flush B and the final Hydrogen content**

Hydrogen content during flush B (ppm)	Final hydrogen content (ppm)
2	3
3	4
3.5	5
4	7
4.5	8
5	11

- The difference between Pblow and Pvac should at least be 700hPa. Values below 600hPa indicate the possibility of leaks in the system.
- The vacuum pressure should drop only slowly. Very sudden drops at the start of the measurement result in unreliable measurements.
- Very 'horizontal' pressure curves around 800hPa can also indicate leaks, unless measurements are made with immersion angles of 90°.
- Vacuum pressures that initially drop and increase afterwards can indicate blocked hoses

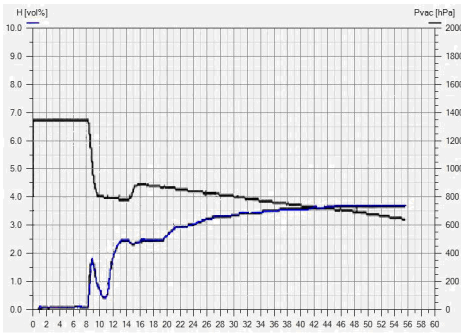
### 7.3.2.2 Examples of measurement results

The following shows an example of a good measurement. The hydrogen level during flush period B of 2.5 ppm results in an equilibrium value of 3.6 ppm.

Equilibrium value = 3.6 ppm

- PH2 = 23.0 hPa
- VAR = 0.02 ppm
- Pbl = 1681 hPa
- Psu = 629 hPa
- K/f = 0.750

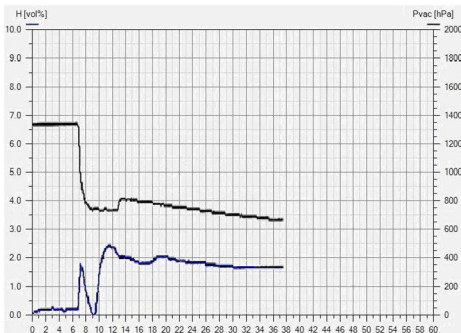
The flush B value (2.4 ppm) correlates quite well with the final value of 3.6 ppm. Furthermore, the pressure curve drops smoothly to a final value of 629 hPa.



Equilibrium value = 1.6 ppm

- PH2 = 4.4 hPa
- VAR = 0.11 ppm
- Pbl = 1640 hPa
- Psu = 635 hPa
- K/f = 0.750

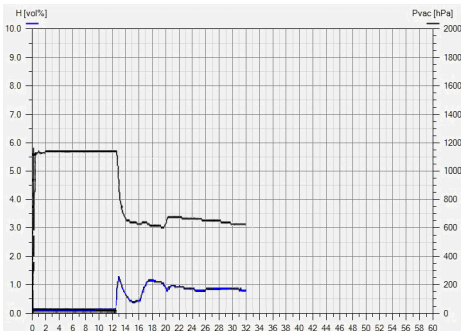
For final values of hydrogen below 2ppm, you should increase the flush A time. This avoids the need to remove from the system residual moisture still present at the start of circulation, which would otherwise result in too a long measurement time. A flush A time of 10 seconds would reduce the measurement to less than 35 seconds.



Equilibrium value = 0.8 ppm

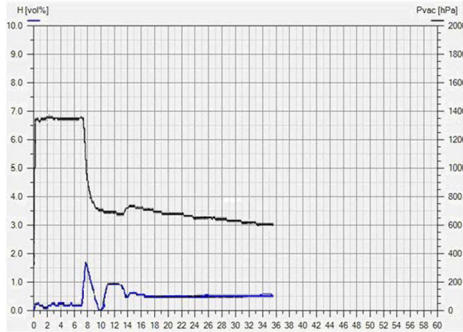
- PH2 = 1.3 hPa
- VAR = 0.11 ppm
- Pbl = 1477 hPa
- Psu = 660 hPa
- K/f = 0.700

By increasing flush A to 12 seconds, reducing curve evaluation time to 28 seconds, measurements can be made within 28 seconds.



Equilibrium value = <0.5 ppm

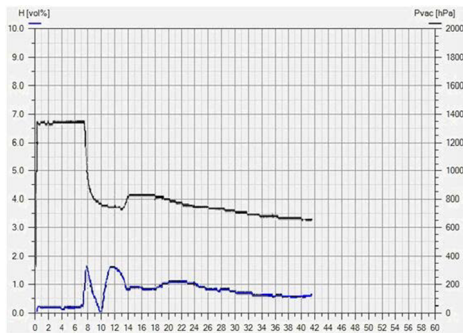
- PH2 = <0.4 hPa
- VAR = 0.11 ppm
- Pbl = 1484 hPa
- Psu = 607 hPa
- K/f = 0.750



The minimum hydrogen limit to be measured is 0.5 ppm. If a hydrogen value is found below 0.5 ppm, the system indicates: <0.5 ppm. This value is only found in degassed melts with degassing times over 30 minutes and in low alloyed steel grades. The following shows a measurement made in an identical steel grade. In this case, a value of 0.6 ppm is found and displayed.

Equilibrium value = 0.6 ppm

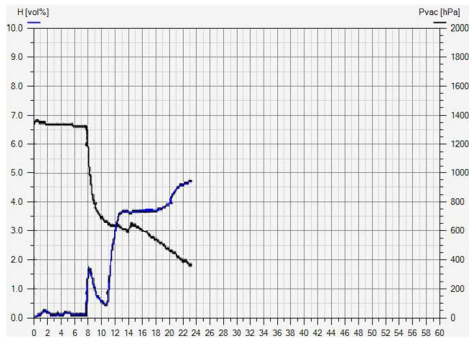
- PH2 = 0.7 hPa
- VAR = 0.09 ppm
- Pbl = 1771 hPa
- Psu = 652 hPa
- K/f = 0.750



Equilibrium value = pressure too low at vacuum line

- PH2 = 39.6 hPa
- VAR = 0.00 ppm
- Pbl = 1351 hPa
- Psu = 388 hPa
- K/f = 0.750

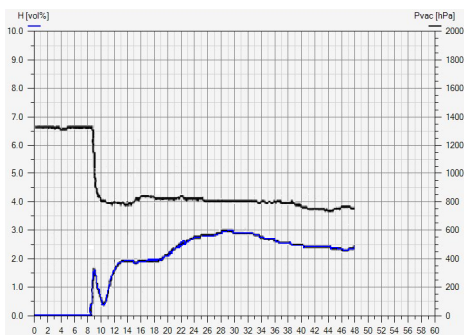
As the vacuum pressure drops very quickly towards 400hPa, gas cannot be circulated to obtain the hydrogen equilibrium. In such a case, the measurement is stopped to avoid incorrect results. Reasons for the failure could be that the oxygen content in the steel (200ppm) is too high, the immersion angle is not vertical enough, the measurement is taken too soon after purging (resulting in sticking of floating slag particles on the porous stone), sulphur is > 0.2%, Ti is > 0.1%, or blocked pneumatic hose.



Equilibrium value = 2.4 ppm

- PH2 = 10.5 hPa
- VAR = 0.13 ppm
- Pbl = 1834 hPa
- Psu = 741 hPa
- K/f = 0.750

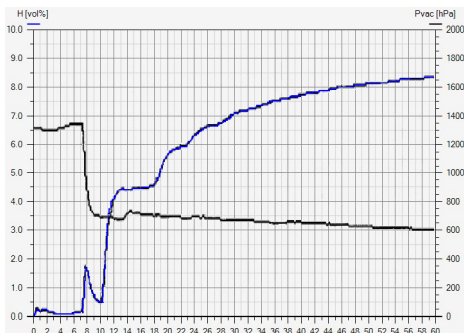
Due to the excessive use of argon in the nozzle, the Hydris system picked up argon gas during measurement. As the thermal conductivity of argon is smaller than nitrogen, this results in values being too low, characterised by a gradual drop of the measurement curve. Intensive stirring in the ladle results in similar curves.



Equilibrium value = 8.3 ppm

- PH2 = 122.3 hPa
- VAR = 0.22 ppm
- Pbl = 1429 hPa
- Psu = 591 hPa
- K/f = 0.750

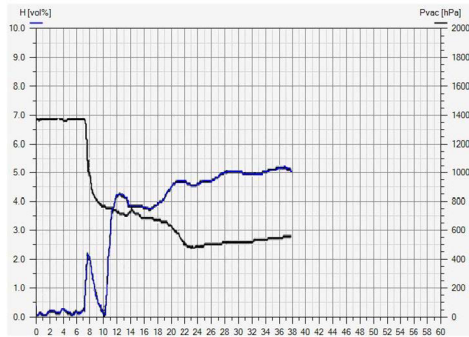
This is a good measurement. The flush B value around 4.5ppm results in a final 8.3ppm value.



Equilibrium value = 5.1 ppm

- PH2 = 25.9 hPa
- VAR = 0.16 ppm
- Pbl = 1435 hPa
- Psu = 560 hPa
- K/f = 1.000

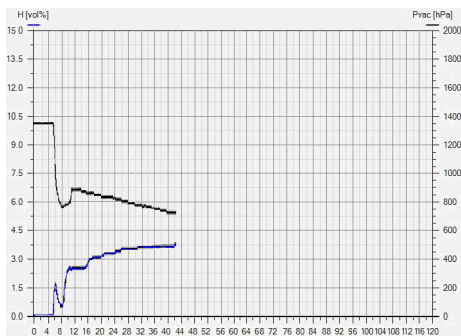
Although the measurement curve looks OK, the pressure curve shows an irregularity. The pressure curve starts to increase after about 30 seconds. This indicates that the pneumatic hose might be blocked. Carry out an air test measurement and a blockage check.



Equilibrium value = 3.7 ppm

- PH2 = 23.7 hPa
- VAR = 0.08 ppm
- Pbl = 1638 hPa
- Psu = 696 hPa
- K/f = 0.750

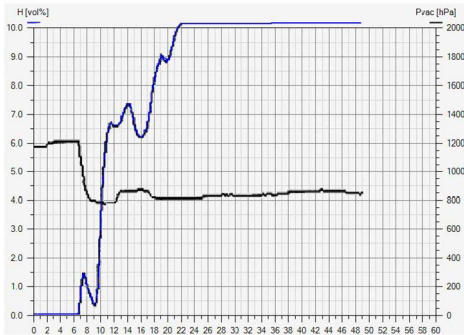
This is a good measurement. The H2 scale is increased from 10 to 15 ppm H.



Equilibrium value = 13.9 ppm

- PH2 = 343.4 hPa
- VAR = 0.24 ppm
- Pbl = 1873 hPa
- Psu = 902 hPa
- K/f = 0.750

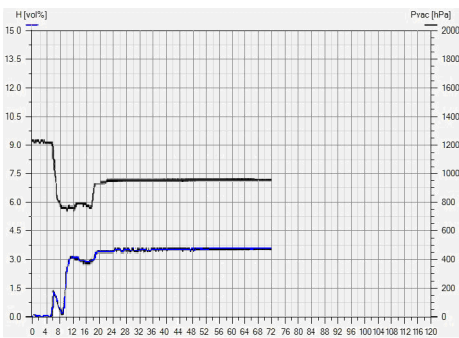
The probe is broken during immersion. This is clearly visible when checking the pressure curve, which increases instead of dropping slowly. The high H2 value (13.9ppm) is also very unusual. The high vacuum pressure of 900hPa is also a good indication of probe failure.



Equilibrium value = 3.7 ppm

- PH2 = 23.8 hPa
- VAR = 0.20 ppm
- Pbl = 1176 hPa
- Psu = 973 hPa
- K/f = 0.750

This measurement has two unusual characteristics. Firstly, the vacuum pressure line is horizontal. Secondly, the difference between Pvac and Pblow is very low (only 200hPa). The reason for the failure is that the pump didn't start during measurement.



## 7.3.3 History

The History Screen shows all the measurements taken with the Hydris® system. On top of the screen (red rectangle), you find search filters to search for a specific measurement.

The screenshot shows the Hydris History screen. At the top, there is a header with 'Hydris Customer - City - Location', the date '3/19/2021', and the time '1:27:10 PM'. Below the header, there is a search filter section with the following options:

- Date: 5/1/2020 To 3/19/2021
- Time: 00:00 to 00:00
- Heat number: [input field]
- Type:  Normal,  Test gas,  Leakage test,  Calibration,  Air test
- Errors: Include errors [dropdown]

Below the search filters, there are three buttons: Search, Export (Excel), and Export (PDF). The main content is a table with the following columns: Details, Time, Heat number, K/f factor, Type, Error, H, PH2, HC, and PHB. The table contains 10 rows of data, with the first 6 rows having an error icon (red triangle) in the Error column. The last 4 rows have numerical values in the H, PH2, HC, and PHB columns.

Details	Time	Heat number	K/f factor	Type	Error	H	PH2	HC	PHB
	3/11/2021 1:52:37 PM	12	0.750	QC					
	3/11/2021 1:51:25 PM	12	0.750	QC					
	3/11/2021 12:07:23 PM	12	0.750	QC					
	3/11/2021 11:37:38 AM	12	0.750	QC					
	3/10/2021 3:49:56 PM	12	0.750	QC					
	3/10/2021 3:45:40 PM	12	0.750	QC					
	3/10/2021 3:44:00 PM	12	0.750	QC		4.2	29.78	4.2	13.27
	3/10/2021 3:37:53 PM	12	0.500	QC				2.7	13.09
	3/10/2021 3:35:21 PM	12	0.500	EQ		2.8	28.99		

At the bottom of the table, there are navigation buttons: <<, <, >, >>. Below the table, there is a footer with navigation icons for Home, History, Maintenance, System tools, and Login, and the Electro-Nite logo.

**Figure 20:** History screen

You can perform the following actions:

- **Search** to show the results filter
- **Export (Excel)** to create a list of measurements to .xls format
- **Export (PDF)** to export the measurement curves in a .pdf document

Click the eye button to see the measurement details.

## 8. Settings

### 8.1 Settings screen

To access the settings screen you need to login with the engineer password ( 5.3 ).

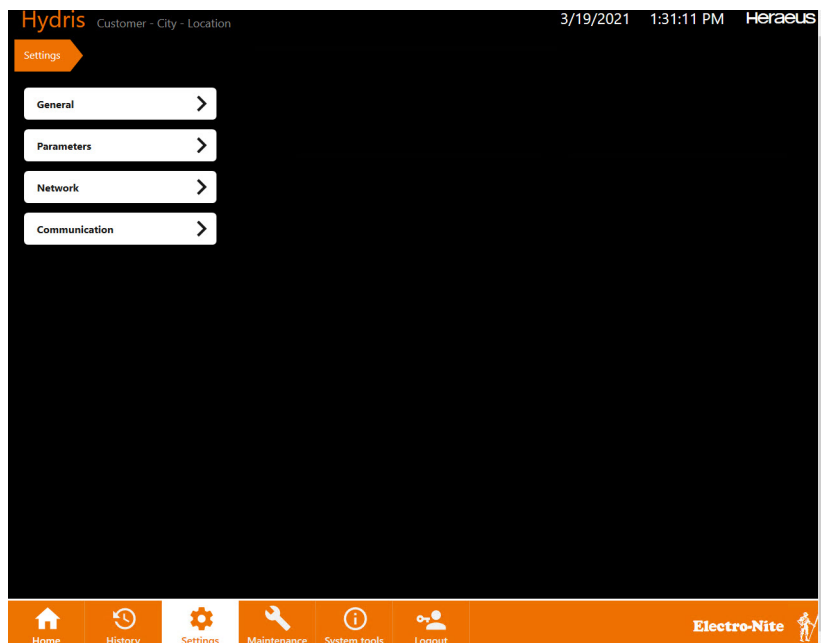


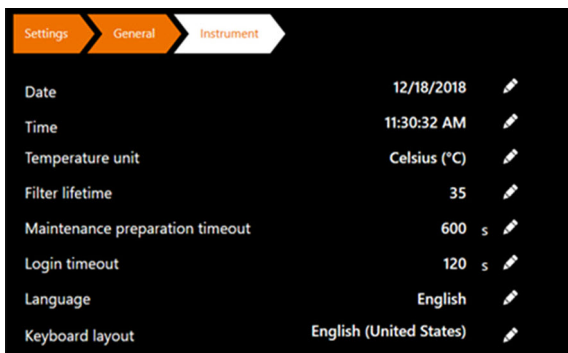
Figure 21: Settings screen

### 8.2 General settings

Table 19: General settings menu

Setting menu	Description	Paragraph
Instrument	Instrument specific settings: date, time, unit, language, filter lifetime, preparation screen timeout.	8.2.1
Customer info	Enter customer specific information to show on the screen header.	8.2.2
Visualization	Graph and result precision settings.	8.2.3
Regional settings	Display of date/time, numeric, and currency data types.	8.2.4

## 8.2.1 Instrument



**Figure 22:** Instrument settings screen

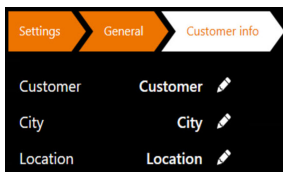
Click the pencil to change the default settings.

Setting	Description (default)
Date	Date used for the instrument
Time	Time used for the instrument
Temperature unit	°C or °F
Filter lifetime	Number of measurements (filter counter) that can be taken before the filter needs to be exchanged. A warning will be shown with every measurement once the filter lifetime is exceeded ( <b>35</b> )
Maintenance preparation timeout	Timeout of maintenance actions. Once the timeout is expired, the system will return to its idle state ( <b>600 s</b> )
Login timeout	Timeout for the login ( <b>120 s</b> )
Language	<b>English</b> /German/French/Chinese/Czech/Spanish/Polish/Portuguese/Russian/Turkish 1
Keyboard layout	<b>English</b> (United States)

1 Restart the client for the language change to take place.

## 8.2.2 Customer info

In this screen you can change customer, city and location data that will be shown in the measurement graph.

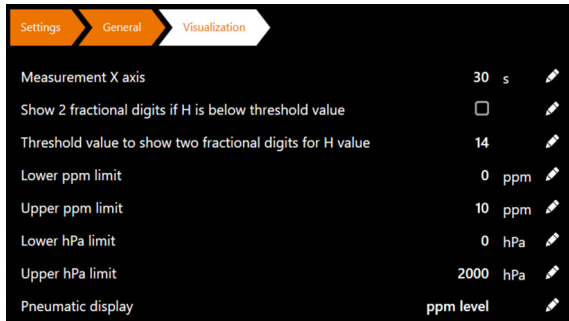


**Figure 23:** Customer info screen

Click the pencil to change the default settings.

Setting	Description
Customer	Name of the customer – shown in the heading of the screen, used for export and remote connection.
City	Name of the city – shown in the heading of the screen, used for export and remote connection.
Location	Name of the location – shown in the heading of the screen, used for export and remote connection.

## 8.2.3 Visualization



**Figure 24:** Visualization screen

Click the pencil to change the default settings.

Setting	Description	Default	Min	Max	Unit
Measurement X axis	Max value for time axis. If exceeded, autogrow is applied.	30	10	100	s
Show 2 fractional digits if H is below threshold value	if Enabled, specifies that Hydro- gen values are shown with two digits after the decimal separator according to the threshold value set in the next parameter.	Enabled	-	-	-
Threshold value to show two fractional digits for H value	specifies the threshold Hydro- gen value below which two digits are shown after the decimal separator.	2.0	2.0	14.0	ppm
Lower ppm limit	Min value for hydrogen axis	0	0	20	ppm
Upper ppm limit	Max value for hydrogen axis	10	0	20	ppm
Lower hPa limit	Min value for pressure axis	0	0	10000	hPa
Upper hPa limit	Max value for pressure axis	2000	0	10000	hPa

## 8.2.4 Regional settings

When you click the Regional settings button the next screen pops-up:

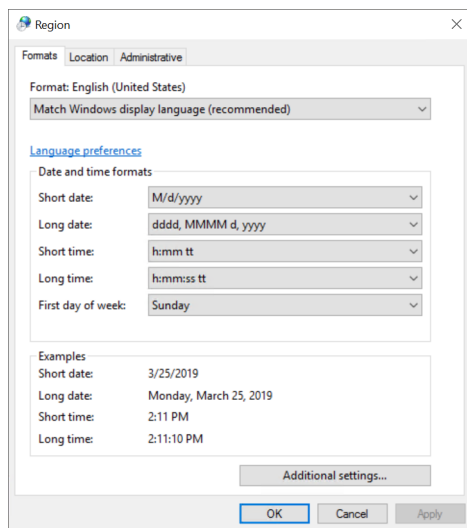
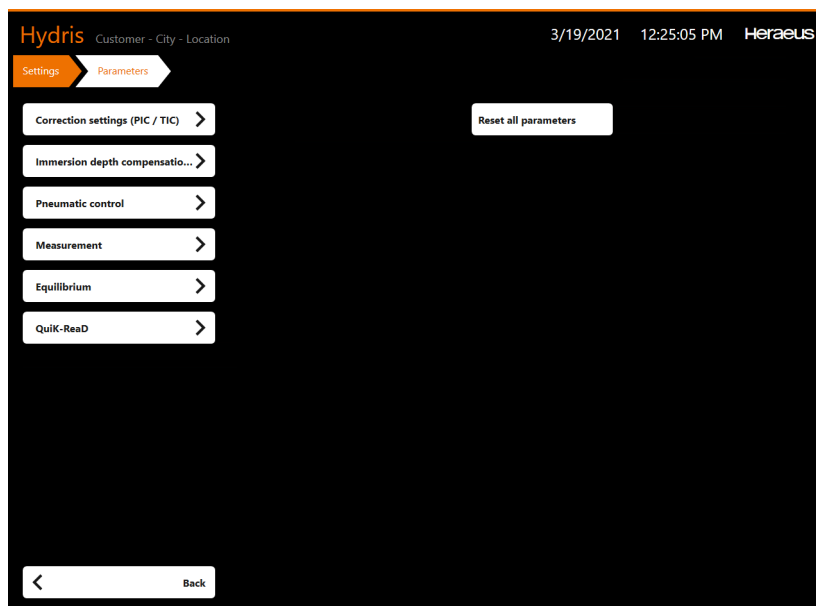


Figure 25: Regional settings screen

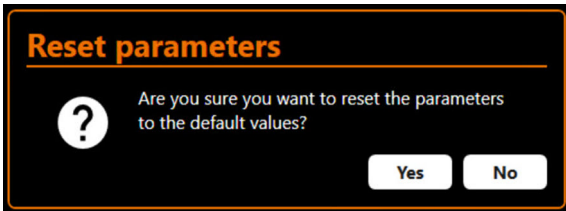
## 8.3 Parameters



### 8.3.1 Resetting all parameters

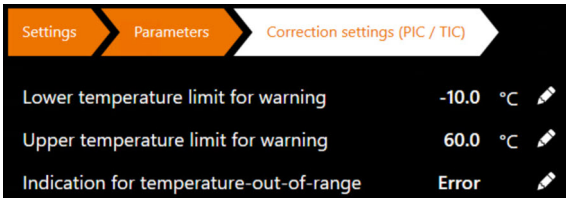
To reset all parameters back to the default values, a reset parameters function is foreseen. Click the **Reset all parameters** button on the top right of your parameters screen.

The next screen pops-up:



Click **Yes** to confirm.

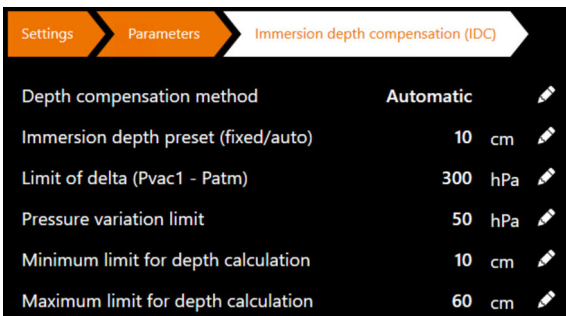
### 8.3.2 Correction settings (PIC/TIC)



Click the pencil to change the default settings.

Setting	Description	Default	Min	Max	Unit
Lower temperature for warning	Below this temperature, a warning or error will be given at the start of the measurement.	-10.0	-20.0	50.0	°C
Upper temperature for warning	Above this temperature, a warning or error will be given at the start of measurement.	60.0	-10.0	70.0	°C
Indication for temperature out of range	Depending on this setting, a warning or error will be given when the temperature is out of range at the start of the measurement to assure good working of the instrument to give an accurate result.	error	warning		-

### 8.3.3 Immersion depth compensation



Click the pencil to change the default settings.

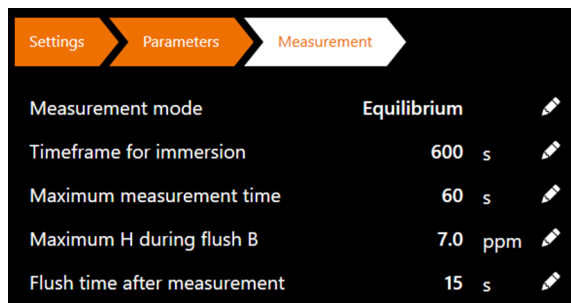
Setting	Description	Default	Min	Max	Unit
Depth compensation method	Compensation method used for depth correction	automatic	disabled/fixed		-
Immersion depth preset	Depth used when compensation method is set to fixed or when automatic compensation is set and cannot be calculated	10	10	130	cm
Limit of delta (Pvac1-Patm)	Max difference between Pvac1 and Patm to calculate immersion depth	300	10	500	hPa
Pressure variation limit	Max variation in pressure	50	10	300	hPa
Minimum limit for depth calculation	When automatic depth detection is enabled, a value will be calculated as from the value set in this parameter	10	0	30	cm
Maximum limit for depth calculation	When automatic depth detection is enabled, a value can be calculated until the value set in this parameter	60	30	100	cm

## 8.3.4 Pneumatic control

Setting	Value	Unit
Pressure limit (pump)	2500	hPa
Pressure limit (gas)	2500	hPa
Pressure limit during measurement	3200	hPa
Vacuum limit at flush (upper)	2600	hPa
Vacuum limit (bottom)	300	hPa
Vacuum limit (upper)	1150	hPa
Reset limit (pressure check)	30	s

Setting	Description	Default	Min	Max	Unit
Pressure limit (pump)	Minimum blow pressure needed to detect a probe. It is also the maximum blow pressure allowed to detect a blockage during a measurement.	2500	0	5000	hPa
Pressure limit (gas)	Maximum gas pressure allowed during flush A to detect a blockage.	4500	0	5000	hPa
Pressure limit during measurement		3200	2000	4000	hPa
Vacuum limit (bottom)	Minimum vacuum pressure allowed during a measurement.	300	0	1000	hPa
Vacuum limit (upper)	Maximum vacuum pressure allowed during a measurement.	1150	0	2000	hPa
Vacuum limit at flush (upper)	is the maximum vacuum pressure to detect a blockage from the start of a measurement up to flush A.	2600	1300	5000	hPa
Reset limit (pressure check)	Amount of time that the 'ready to measure' status remains valid. If the re-initialisation limit has been exceeded the measurement must be restarted. If a vacuum or blow pressure error occurs before the reset limit time, the measurement is stopped immediately.	30	0	120	s

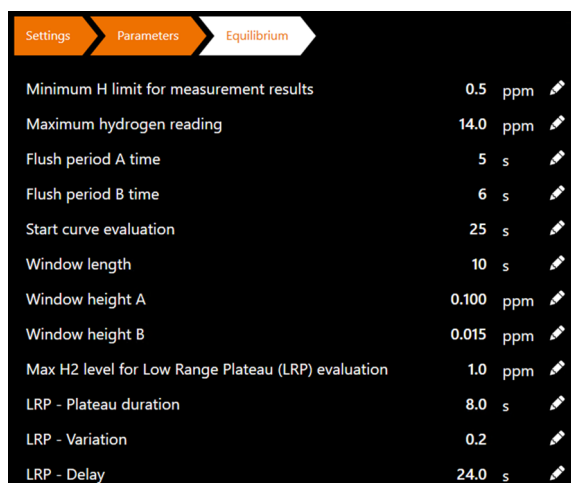
## 8.3.5 Measurement



Click the pencil to change the default settings.

Setting	Description	Default	Min	Max	Unit
Measurement mode		EQ			-
Timeframe for immersion	Timeperiod within which a measurement has to be started.	600	180	900	s
Maximum measurement time	Maximum time a measurement can take.	60	10	120	s
Maximum H during flush B	Maximum hydrogen content during flush B.	7.0	0.0	10.0	ppm
Flush time after measurement	Time the system is flushed after a measurement.	15	10	30	s

## 8.3.6 Equilibrium



Click the pencil to change the default settings.

Setting	Description	Default	Min	Max	Unit
Minimum H limit for measurement results	Min value of hydrogen content for results	0.5	0.0	5.0	ppm
Maximum hydrogen reading	Max value of hydrogen content for results	14.0	1.0	20.0	ppm
Flush period A time	Time for the initial nitrogen-purgingstep to clean the measuring system.	5	0	20	s
Flush period B time	Time that nitrogencarrier gas is injected into the steel. The nitrogen carrier gas is recovered from the steel and exhausted in the air.	5	0	20	s
Start curve evaluation	Delay after which curve can be evaluated	35	0	120	s
Window length	Length of window for hydrogen calculation	10	1	20	s
Window height A	Height of window for hydrogen calculation	0.100	0.000	1.000	ppm
Window height B	Height of window for hydrogen calculation	0.015	0.000	0.200	ppm
Max H level for Low Range Plateau (LRP) evaluation	Max limit for low range algorithm to apply	1.0	0.0	1.5	Ppm
LRP – Plateau duration	Length of window for low range algorithm	8.0	5.0	10.0	s
LRP – Variation	Variation for low range algorithm	0.2	0.0	0.5	

## 8.3.7 QuiK-Read

Setting	Value	Unit
Flush period A time	10	s
Maximum time	15	s
Evaluation delay	5	s
Plateau duration	5	s
Window height A	0.050	ppm
Window height B	0.008	ppm
Calculation limit (minimum)	2.5	ppm
M - calculation factor A	1.9823	
M - calculation factor B	0.0319	
M - calculation factor C	0.0000	

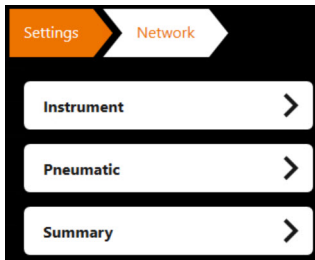
Setting	Description	Default	Min	Max	Unit
Flush period A time	Time for the initial nitrogen-purgingstep to clean the measuring system.	10	0	20	s
Maximum time		15	0	90	s
Evaluation delay	Delay after which curve can be evaluated	5	0	20	s
Plateau duration		5	0	10	s
Window height A	Height of window for hydrogen calculation	0.050	0.000	1.000	ppm
Window height B	Height of window for hydrogen calculation	0.008	0.000	0.200	ppm
Calculation limit (min)		2.5	0.0	10.0	ppm
M - calculation factor A		1.9823	0.0000	10.0000	
M - calculation factor B		0.0319	0.0000	10.0000	
M - calculation factor C		0.0000	0.0000	10.0000	

## 8.4 Network

By default, the instrument connects automatically to the pneumatic unit. But when the communication needs to go over the plant network, the network settings need to be adjusted.

To do so, connect the pneumatic unit directly to the instrument to set it up.

First, change the IP address and destination address in the pneumatic unit (because the pneumatic unit will connect to the instrument) and then configure the instrument so that the pneumatic unit can connect to it.



The network settings are split up into the settings for

- The **instrument** itself, to enable:
  - Communication with the pneumatic unit
  - Communication with the plant network
- The **pneumatic** unit, to enable:
  - Communication with the panel PC

### 8.4.1 Instrument network settings

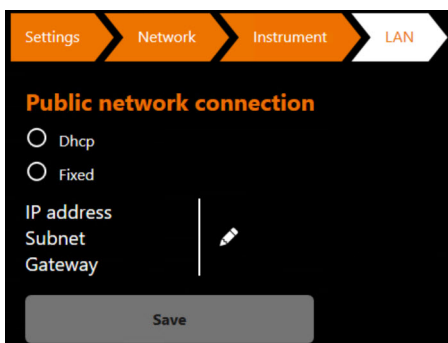
The instrument settings are the adapter settings on the instrument itself. Use these settings to set an IP address for the instrument.

The network ports related to these settings are labelled on the back of the instrument:

- Pneumatic: Going from the instrument to the pneumatic unit
- LAN: Going from the instrument to the plant PC

#### 8.4.1.1 LAN network

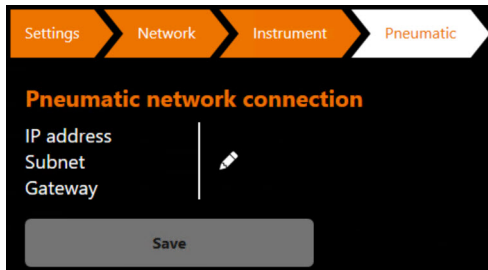
Ask your local network administrator which network settings to apply. The public network can be used to remotely connect to the instrument (see section 6.4 ) or enable level 2 communication with the plant network (see section 9.1 ).



- DHCP: automatic allocation of the IP address by the plant network
- Fixed

### 8.4.1.2 Pneumatic unit network

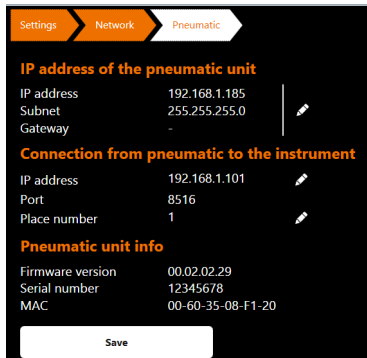
This setting enables the user to set up the port at the instrument side where the pneumatic unit can connect to.



This IP address is the IP address of the Hydris® instrument. The destination IP address of the pneumatic unit should be set to this IP address to enable the pneumatic unit to find the Hydris instrument (see next paragraph).

## 8.4.2 Pneumatic unit network settings

The Pneumatic unit network settings are the settings configured in the pneumatic unit itself. They can only be displayed when the pneumatic unit is connected. This menu item has the following settings:



- IP address of the pneumatic unit: IP settings configured in the pneumatic unit itself, used to connect the pneumatic unit to the plant network.
- Connection from pneumatic unit to the instrument: IP address where the instrument can be found. This setting should be set to the IP address of the instrument, as described in section 9.3.1.2.
- Pneumatic unit info: information about the pneumatic unit to be able to identify its calibration data if necessary.

## 8.4.3 Network summary

A network overview can be retrieved from [Settings](#) > [Network](#) > [Summary](#). The meaning of the different settings is given in the summary below.

The screenshot shows a settings menu with three sections: 'Instrument (pneumatic network connection)', 'Instrument (public network connection)', and 'Pneumatic network connection'. Each section lists IP address, Subnet, Gateway, and MAC. Callout boxes provide additional context for each section.

Section	Field	Value	Callout
Instrument (pneumatic network connection)	IP address	192.168.1.101	Connection from the instrument to the pneumatic unit Saved on: instrument
	Subnet	255.255.255.0	
	Gateway	-	
	MAC	EC-B1-D7-93-DC-DF	
Instrument (public network connection)	IP address	172.30.249.30	Connection from the instrument to the plant network Saved on: instrument
	Subnet	255.255.255.0	
	Gateway	172.30.249.1	
	MAC	80-19-34-AC-12-F5	
Pneumatic network connection	IP address	192.168.1.185	Pneumatic unit IP address Saved on: pneumatic unit Connect to: instrument
	Subnet	255.255.255.0	
	Gateway	-	
	MAC	00-60-35-08-F1-20	

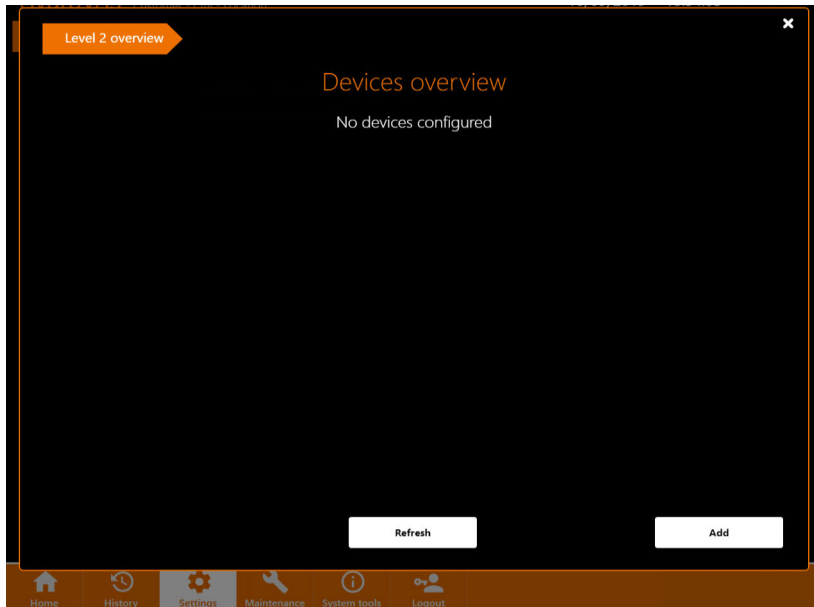
## 9. Level2 Communication

The Level2 communication is used to configure data telegrams and their destinations. That is, what the data telegrams contain and where they will be sent.

### 9.1 Configure Level2 communication

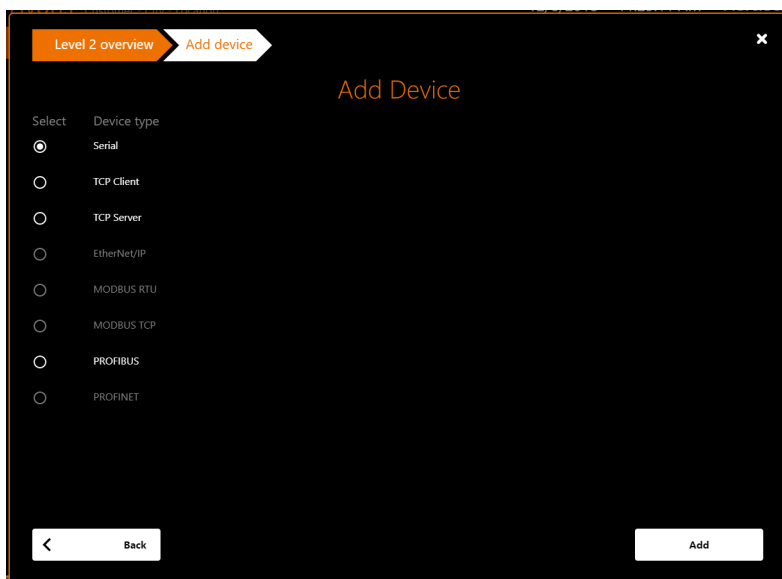
To configure level2 communication on the Hydris® system perform the next steps:

- 1 Login and go to **Settings > Communication > Configuration**.



This screen gives an overview of the Level2 devices installed. At start up this screen is empty. You can start to add devices.

- 2 Click **Add**.



You get a list of devices. The devices marked in white and bold are active and can be selected.

- 3 Select which device you would like to add with the radio button. Click **Add**.

You get an overview of the device settings. By clicking the dropdown menu you can adapt these setting.

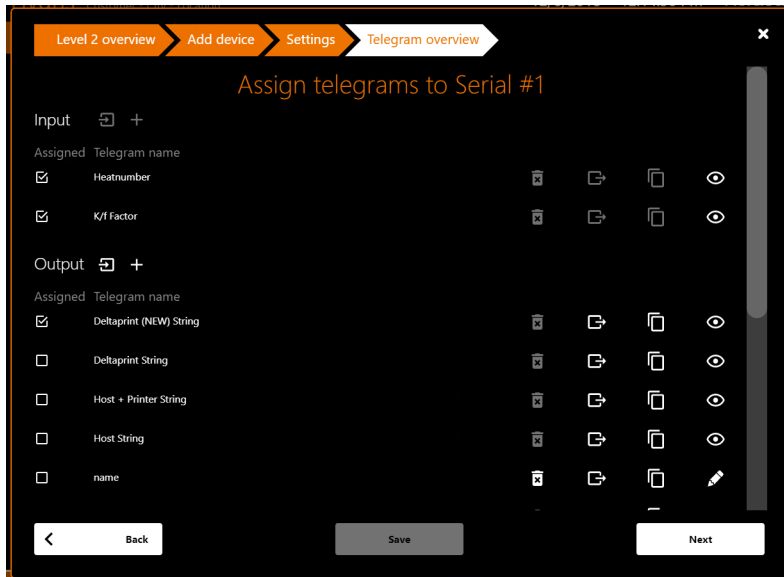
- 4 Click **Next**.

You get an overview of telegrams that can be assigned to this device.

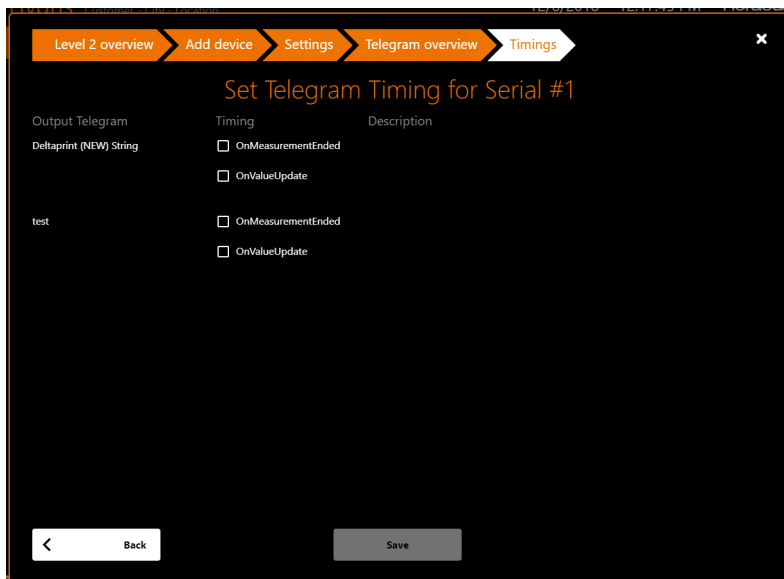
- 5 Click the eye icon to view the input or output telegrams.

**Note:** The input telegrams are preset and cannot be changed, only viewed. A set of frequently used output telegrams is also already defined. These can be viewed, copied, changed and exported. Default telegrams cannot be deleted!

## 6 To change the preset output telegrams:



- a Click the **Copy** button.
  - b Make changes in the copy.
  - c Test the copy.
  - d Enter a Name and Save this as a new telegram.
  - e Click the pencil to make changes afterwards .
- 7 To export the entire telegram on the screen to a file, click the **Export** button.
- 8 Telegrams to be used can be selected on the Telegram Overview screen, by clicking the boxes in front of the Telegram name. Click **Next**.



On this screen you can select the timing when the telegram is sent.

- 9 Select the timing by clicking the box in front. Click **Save**.

## 9.2 Device settings

### 9.2.1 Serial

**Table 20: Serial device settings**

Name	Options (default)	Description
Port	COMX	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Baud rate	<b>300</b> – 600 – 1200 – 2400 – 4800 – 9600 – 19200 – 38400 – 57600 115200	Speed of the serial communication
Parity	<b>None</b> /Even/Odd/Mark/Space	Parity used for the serial communication
Databits	<b>8</b> or 7	Number of data bits used for the serial communication
Stopbits	<b>One</b> /Two/OneAndAHalf	Number of stop bits used for the serial communication
Protocol	<b>None</b> /Siemens3964/Siemens3964R/Siemens3964_RK512/Siemens3964R_RK512/StxEtx	Protocol used for the serial communication
Mode	<b>TTY</b> /RS232	Measurement mode for the serial communication, depending on the hardware
Rx loop mode	<b>Passive</b> /Active	Only for TTY – mode for the receiving side
Tx loop mode	<b>Passive</b> /Active	Only for TTY – mode for the transmitting side

### 9.2.2 TCP Settings

**Table 21: TCP Client settings**

Name	Options (default)	Function
Port	<b>1024</b>	Port opened at the server side that the Hydris® software connects to
IP address	192.168.1.1	IP address of the server where the client needs to connect to

**Table 22: TCP Server settings**

Name	Options (default)	Function
Port	<b>1024</b>	Port opened on the Hydris® software where the customer TCP client will connect to

## 9.2.3 Ethernet/IP

**Table 23: Ethernet/IP settings**

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
IP address	192.168.1.1	IP address of the server where the client needs to connect to
Subnet mask	255.255.255.0	
Assembly instance input	150	
Assembly instance output	100	
Input Register Size (bytes)	64	
Output Register Size (bytes)	244	

## 9.2.4 Modbus

**Table 24: Modbus RTU settings**

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Baud rate	1200 – 2400 – 4800 – <b>9600</b> – 19200 – 38400	Speed of the serial communication
Parity	<b>NoneWithOneStopBit</b> NoneWithTwoStopBits OddParityWithOneStopBit EvenParityWithOneStopBit	Parity used for the serial communication
Slave ID	<b>20</b>	
Input Register Size	<b>0</b>	
Output Register Size	<b>128</b>	

**Table 25: Modbus TCP settings**

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
IP address	192.168.1.1	IP address of the server where the client needs to connect to
Subnet mask	255.255.255.0	
Input Register Size (bytes)	<b>64</b>	
Output Register Size (bytes)	<b>244</b>	

## 9.2.5 Profibus

**Table 26: Profibus settings**

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Device address	30	Node ID for the profibus connection
Number of data units	1-16	
Direction	<b>Output</b> /Input/InputOutput	
Type	<b>Word</b> /Byte	

## 9.2.6 Profinet

**Table 27: Profinet**

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Modules	Output – 1 – Byte Output – 1 – Word Output – 8 – Word <b>Output – 16 – Word</b> Input – 1 – Byte Input – 1 – Word Input – 8 – Word Input – 16 – Word	
<a href="#">Download GSDML</a>		

## 9.3 Default Telegrams

### 9.3.1 Serial/TCP protocols

#### 9.3.1.1 Input

The following telegrams can be accepted for serial/TCP communication:

Heat number

```
#htnr|S,8|
```

Set Heat number: HNXXXXXXXXX where XXXXXXXXX is an alphanumeric value.

### K/f factor

Set K/f factor: KFX.XXX where X.XXX is a value between 0.200 and 2.000

```
#kf|S,5|
```

### 9.3.1.2 Output

#### Deltaprint (NEW) String

```
*****PBL: #PBLow|C,4,1,-, | hPa#$0DPSU: #PVAC|C,4,1,-, |
hPa#$0DK/f: #KF|C,2,3,-, |#$0DDEP: #IMMDEPTH|C,3,0,-, | cm#$0DCAT: #CATHTMP|
C,3,1,-, |
C#$0DPHB: #PHB|C,3,2,-, | hPa#$0DH2C: #HC|C,2,1,-, | ppm#$0DPH2: #PH2|C,3,2,-, |
hPa#$0D[H]: #H|C,2,1,-, | ppm#$0DVAR: #VAR|C,2,2,-, | ppm#$0DTIME: #DATE|
T,hh:mm|
#$0DDATE: #DATE|T,DD-MM-YY|#$0DHEAT: #HN|S,8|#$0DHYDRIS - LAB #PL|C,2,0|#
$0D*****
```

Preview Hex	Preview Ascii
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F	PBL: 0000.0 hPa
7F 7F 7F 7F 0F	PSU: 0000.0 hPa
2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A	K/f: 00.000
2A 2A 2A 2A 50	DEP: 000 cm
42 4C 3A 20 30 30 30 30 2E 30 20	CAT: 000.0 C
68 50 61 0D 50	PHB: 000.00 hPa
53 55 3A 20 30 30 30 30 2E 30 20	H2C: 00.0 ppm
68 50 61 0D 4B	PH2: 000.00 hPa
2F 66 3A 20 30 30 2E 30 30 30 0D	[H]: 00.0 ppm
44 45 50 3A 20	VAR: 00.00 ppm
20 20 20 30 30 30 20 63 6D 0D 43	TIME: 00:00
41 54 3A 20 20	DATE: 01-01-01
30 30 30 2E 30 20 43 0D 50 48 42	HEAT:
3A 20 30 30 30	HYDRIS - LAB 00
2E 30 30 20 68 50 61 0D 48 32 43	
3A 20 20 20 30	
30 2E 30 20 70 70 6D 0D 50 48 32	
3A 20 30 30 30	
2E 30 30 20 68 50 61 0D 5B 48 5D	
3A 20 20 20 30	
30 2E 30 20 70 70 6D 0D 56 41 52	
3A 20 20 30 30	
2E 30 30 20 70 70 6D 0D 54 49 4D	
45 3A 20 30 30	
3A 30 30 0D 44 41 54 45 3A 20 30	
31 2D 30 31 2D	
30 31 0D 48 45 41 54 3A 20 20 20	
20 20 20 20 20	
20 0D 48 59 44 52 49 53 20 2D 20	
4C 41 42 20 30	
30 0D 2A 2A 2A 2A 2A 2A 2A 2A	
2A 2A 2A 2A 2A	
2A 0D 0D	

#### Deltaprint String

```
#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#$7F#
$0F*****PBL : #PBLOW|C,4,0,-, | hPa#$0DPSU : #PVAC|C,4,0,-, | hPa#
$0DK/f : #KF|C,2,2,-, |#$0DPH2 : #PH2|C,3,2,-, |hPa#$0DVAR : #VAR|C,2,1,-, |
ppm#$0D[H] : #H|C,2,1,-, | ppm#$0DTIME: #DATE|T,hh:mm|#$0DDATE: #DATE|T,DD/
MM|#$0DHEAT: #HN|S,8|#$0DHYDRIS - LAB #PL|C,2,0|#$0D*****#$0D#$0D
```

Preview Hex	Preview Ascii
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F	PBL : 1264 hPa
7F 7F 7F 7F 0F	PSU : 504 hPa
2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A	K/f : 1.10
2A 2A 2A 2A 50	PH2 : 29.22hPa
42 4C 20 3A 20 31 32 36 34 20 68	VAR : 0.2 ppm
50 61 0D 50 53	[H] : 6.1 ppm
55 20 3A 20 20 35 30 34 20 68 50	TIME: 10:21
61 0D 4B 2F 66	DATE: 18/12
20 3A 20 20 20 31 2E 31 30 0D 50	HEAT: 22
48 32 20 3A 20	HYDRIS - LAB 01
20 32 39 2E 32 32 68 50 61 0D 56	
41 52 20 3A 20	
20 20 30 2E 32 20 70 70 6D 0D 5B	
48 5D 20 3A 20	
20 20 36 2E 31 20 70 70 6D 0D 54	
49 4D 45 3A 20	
20 31 30 3A 32 31 0D 44 41 54 45	
3A 20 20 31 38	
2F 31 32 0D 48 45 41 54 3A 20 20	
32 32 20 20 20	
20 20 20 0D 48 59 44 52 49 53 20	
2D 20 4C 41 42	
20 30 31 0D 2A 2A 2A 2A 2A 2A 2A	
2A 2A 2A 2A 2A	
2A 2A 2A 0D 0D	

### Host + Printer String

```
#$7F#$05#$11 HEAT #HN|S,8|#$0D#$7F#$05#$11 DATE #DATE|T,DD/MM|#$0D#$7F#
$05#$11 TIME #DATE|T,hh:mm|#$0D#$7F#$05#$11 K/f #KF|C,1,2|#$0D#$7F#$05#
$11 PH2 #PH2|C,3,2,-, |#$0D#$7F#$05#$11 PPM #H|C,2,1,-, |#$0D#$7F#$05#$11
HYDRIS-LAB #PL|C,2,0|#$0D#$7F#$05#$11-----#$0D>!#$7E[HL#PL|C,2,0|#
$23 #H|C,2,1,-, |>/"#HN|S,8|*#PH2|C,3,2,-, |+#KF|C,2,2,-, |#$7E]
```

Preview Hex	Preview Ascii
7F 05 11 20 20 48 45 41 54 20 32	HEAT 22
32 20 20 20 20	DATE 18/12
20 20 0D 7F 05 11 20 20 20 44 41	TIME 10:21
54 45 20 20 31	K/f 1.10
38 2F 31 32 0D 7F 05 11 20 20 20	PH2 29.22
54 49 4D 45 20	PPM 6.1
20 31 30 3A 32 31 0D 7F 05 11 20	HYDRIS-LAB 01
20 20 4B 2F 66	-----
20 20 20 20 31 2E 31 30 0D 7F 05	>!~[HL01# 6.1>/"22 * 29.22+
11 20 20 20 50	1.10~]
48 32 20 20 20 32 39 2E 32 32 0D	
7F 05 11 20 20	
20 50 50 4D 20 20 20 20 36 2E 31	
0D 7F 05 11 20	
20 48 59 44 52 49 53 2D 4C 41 42	
20 30 31 0D 7F	
05 11 2D 2D 2D 2D 2D 2D 2D	
2D 2D 2D 2D 2D	
2D 2D 2D 0D 3E 21 7E 5B 48 4C 30	
31 23 20 20 36	
2E 31 3E 2F 22 32 32 20 20 20 20	
20 20 2A 20 32	
39 2E 32 32 2B 20 31 2E 31 30 7E	
5D	

### Host String

```
>!#$%&'[HL#PL|C,2,0|#$23 #H|C,2,1,-, |>/"#HN|S,8|*#PH2|C,3,2,-, |+#KF|C,2,2,-, |# $7E]
```

Preview Hex	Preview Ascii
3E 21 7E 5B 48 4C 30 31 23 20 20	>!~[HL01# 6.1>/"22 * 29.22+
36 2E 31 3E 2F	1.10~]
22 32 32 20 20 20 20 20 20 2A 20	
32 39 2E 32 32	
2B 20 31 2E 31 30 7E 5D	

### One Row

```
# $02 HEAT #HN|S,8| DATE #DATE|T,DD/MM| TIME #DATE|T,hh:mm| K/f #KF|C,2,2,-, |
PH2 #PH2|C,3,2,-, | PPM #H|C,2,1,-, | HYDRIS-LAB #PL|C,2,0|# $0D#$0D#$03
```

Preview Hex	Preview Ascii
02 20 48 45 41 54 20 32 32 20 20	HEAT 22
20 20 20 20 20	DATE 18/12
44 41 54 45 20 31 38 2F 31 32 20	TIME 10:21
54 49 4D 45 20	K/f 1.10
31 30 3A 32 31 20 4B 2F 66 20 20	PH2 29.22
31 2E 31 30 20	PPM 6.1
50 48 32 20 20 32 39 2E 32 32 20	HYDRIS-LAB 01
50 50 4D 20 20	
36 2E 31 20 48 59 44 52 49 53 2D	
4C 41 42 20 30	
31 0D 0A 03	

### One Row (NEW)

```
# $02 HEAT #HN|S,8| DATE #DATE|T,DD-MM-YY| TIME #DATE|T,hh:mm| K/f#KF|C,2,3,-,
| DEP #IMMDEPTH|C,3,0,-, | CAT#CATHTMP|C,3,1,-, | PH2 #PH2|C,3,2,-, | PPM #H|
C,2,1,-, | PHB #PHB|C,3,2,-, | H2C #HC|C,2,1,-, | VAR#VAR|C,2,2,-, | PBL #PBL|
C,4,1,-, | PSU #PVAC|C,4,1,-, | HYDRIS-LAB #PL|C,2,0|# $0D#$0D#$03
```

Preview Hex	Preview Ascii
02 20 48 45 41 54 20 32 32 20 20	HEAT 22
20 20 20 20 20	DATE 18-12-18
44 41 54 45 20 31 38 2D 31 32 2D	TIME 10:21
31 38 20 54 49	K/f 1.100
4D 45 20 31 30 3A 32 31 20 4B 2F	DEP 11
66 20 31 2E 31	CAT 25.8
30 30 20 44 45 50 20 20 31 31 20	PH2 29.22
43 41 54 20 32	PPM 6.1
35 2E 38 20 50 48 32 20 20 32 39	PHB 000.00
2E 32 32 20 50	H2C 00.0
50 4D 20 20 36 2E 31 20 50 48 42	VAR 0.19
20 30 30 30 2E	PBL 1264.4
30 30 20 48 32 43 20 30 30 2E 30	PSU 503.6
20 56 41 52 20	HYDRIS-LAB 01
30 2E 31 39 20 50 42 4C 20 31 32	
36 34 2E 34 20	
50 53 55 20 20 35 30 33 2E 36 20	
48 59 44 52 49	
53 2D 4C 41 42 20 30 31 0D 0D 03	

### Printer (NEW) String

```
# $7F#$05#$11 HEAT #HN|S,8|# $0D#$7F#$05#$11 DATE #DATE|T,DD-MM-YY|# $0D#$7F#$05#
$11 TIME #DATE|T,hh:mm|# $0D#$7F#$05#$11 K/f #KF|C,2,3,-,|# $0D#$7F#$05#
$11 CAT #CATHTMP|C,3,1,-,|# $0D#$7F#$05#$11 DEPTH #IMMDEPTH|C,3,0,-,|# $0D#
$7F#$05#$11 PHB #PHB|C,3,2,-,|# $0D#$7F#$05#$11 H2C #HC|C,2,1,-,|# $0D#
$7F#$05#$11 PH2 #PH2|C,3,2,-,|# $0D#$7F#$05#$11 PPM #H|C,2,1,-,|# $0D#$7F#
```

```

$05#$11 VAR #VAR|C,2,2,-,|#0D#$7F#$05#$11 PBL #PLOW|C,4,1,-,|#0D#$7F#
$05#$11 PSU #PVAC|C,4,1,-,|#0D#$7F#$05#$11 HYDRIS-LAB #PL|C,2,0|#0D#$7F#
$05#$11-----#0D

```

Preview Hex	Preview Ascii
7F 05 11 20 20 48 45 41 54 20 32	HEAT 22
32 20 20 20 20	DATE 18-12-18
20 20 0D 7F 05 11 20 20 44 41 54	TIME 10:21
45 20 31 38 2D	K/f 1.100
31 32 2D 31 38 0D 7F 05 11 20 20	CAT 25.8
54 49 4D 45 20	DEPTH 11
20 31 30 3A 32 31 0D 7F 05 11 20	PHB 000.00
20 20 4B 2F 66	H2C 00.0
20 20 20 20 20 31 2E 31 30 30 0D	PH2 29.22
7F 05 11 20 20	PPM 6.1
43 41 54 20 20 20 32 35 2E 38 0D	VAR 0.19
7F 05 11 20 20	PBL 1264.4
44 45 50 54 48 20 20 31 31 0D 7F	PSU 503.6
05 11 20 20 50	HYDRIS-LAB 01
48 42 20 20 20 30 30 30 2E 30 30	
0D 7F 05 11 20	
20 48 32 43 20 20 20 30 30 2E 30	
0D 7F 05 11 20	
20 50 48 32 20 20 20 20 32 39 2E	
32 32 0D 7F 05	
11 20 20 50 50 4D 20 20 20 20 36	
2E 31 0D 7F 05	
11 20 20 56 41 52 20 20 20 30 2E	
31 39 0D 7F 05	
11 20 20 50 42 4C 20 20 20 31 32	
36 34 2E 34 0D	
7F 05 11 20 20 50 53 55 20 20 20	
20 35 30 33 2E	
36 0D 7F 05 11 20 20 48 59 44 52	
49 53 2D 4C 41	
42 20 30 31 0D 7F 05 11 2D 2D 2D	
2D 2D 2D 2D 2D	
2D 2D 2D 2D 2D 2D 2D 2D 2D 0D	

### Printer String

```

#$7F#$05#$11 HEAT #HN|S,8|#0D#$7F#$05#$11 DATE #DATE|T,DD/MM|#0D#$7F#
$05#$11 TIME #DATE|T,hh:mm|#0D#$7F#$05#$11 K/f #KF|C,1,2|#0D#$7F#$05#
$11 PH2 #PH2|C,3,2,-,|#0D#$7F#$05#$11 PPM #H|C,2,1,-,|#0D#$7F#$05#$11
HYDRIS-LAB #PL|C,2,0|#0D#$7F#$05#$11-----#0D#0D

```

Preview Hex	Preview Ascii
7F 05 11 20 20 48 45 41 54 20 32	HEAT 22
32 20 20 20 20	DATE 18/12
20 20 0D 7F 05 11 20 20 20 44 41	TIME 10:21
54 45 20 20 31	K/f 1.10
38 2F 31 32 0D 7F 05 11 20 20 20	PH2 29.22
54 49 4D 45 20	PPM 6.1
20 31 30 3A 32 31 0D 7F 05 11 20	HYDRIS-LAB 01
20 20 4B 2F 66	
20 20 20 20 31 2E 31 30 0D 7F 05	
11 20 20 20 50	
48 32 20 20 20 32 39 2E 32 32 0D	
7F 05 11 20 20	
20 50 50 4D 20 20 20 20 36 2E 31	
0D 7F 05 11 20	
20 48 59 44 52 49 53 2D 4C 41 42	
20 30 31 0D 7F	
05 11 2D 2D 2D 2D 2D 2D 2D	
2D 2D 2D 2D 2D	
2D 2D 2D 0D 0D	

### Teleheader String with Fixed header

```
#00#00AD#B4#01#00#3F#FF#FFHL #PL|C,2,0| HT #HN|S,8| DA #DATE|T,DD/YY|
TI #DATE|T,hh:mm| H #H|C,2,1,-, | VA #VAR|C,2,1,-, | PH #PH2|C,3,2,-, | KF #KF|
C,2,2,-, | PB #PBLOW|C,4,0,-, | PS #PVAC|C,4,0,-, |
```

Preview Hex	Preview Ascii
00 00 41 44 B4 01 00 3F FF FF 48	AD????HL 01
4C 20 30 31 20	HT 22
48 54 20 32 32 20 20 20 20 20 20	DA 18/18
20 44 41 20 31	TI 10:21
38 2F 31 38 20 54 49 20 31 30 3A	H 6.1
32 31 20 48 20	VA 0.2
20 20 36 2E 31 20 56 41 20 20 30	PH 29.22
2E 32 20 50 48	KF 1.10
20 20 32 39 2E 32 32 20 4B 46 20	PB 1264
20 31 2E 31 30	PS 504
20 50 42 20 31 32 36 34 20 50 53	
20 20 35 30 34	

### Teleheader String with Fixed header (NEW)

```
#00#00AD#B4#01#00#3F#FF#FFHL #PL|C,2,0| HT #HN|S,8| DA #DATE|T,DD-MM-YY|
TI #DATE|T,hh:mm| KF #KF|C,1,3| DE #IMMDEPTH|C,3,0,-, | CT #CATHTMP|C,2,1,-, |
PH #PH2|C,3,2,-, | H #H|C,2,1,-, | VA#VAR|C,2,2,-, | HP #HC|C,2,1,-, | HC #PHB|
C,3,2,-, | PB #PBLOW|C,4,1,-, | PS #PVAC|C,4,1,-, |
```

Preview Hex	Preview Ascii
00 00 41 44 B4 01 00 3F FF FF 48	AD????HL 01 HT 22
4C 20 30 31 20	DA 18-12-18
48 54 20 32 32 20 20 20 20 20 20	TI 10:21
20 44 41 20 31	KF 1.100
38 2D 31 32 2D 31 38 20 54 49 20	DE 11
31 30 3A 32 31	CT 25.8
20 4B 46 20 31 2E 31 30 30 20 44	PH 29.22
45 20 20 31 31	H 6.1
20 43 54 20 32 35 2E 38 20 50 48	VA 0.19
20 20 32 39 2E	HP 00.0
32 32 20 48 20 20 20 36 2E 31 20	HC 000.00
56 41 20 30 2E	PB 1264.4
31 39 20 48 50 20 30 30 2E 30 20	PS 503.6
48 43 20 30 30	
30 2E 30 30 20 50 42 20 31 32 36	
34 2E 34 20 50	
53 20 20 35 30 33 2E 36	

### Teleheader String without header

```
HL #PL|C,2,0| HT #HN|S,8| DA #DATE|T,DD/MM| TI #DATE|T,hh:mm| H #H|C,2,1,-, |
VA #VAR|C,2,1,-, | PH #PH2|C,3,2,-, | KF #KF|C,2,2,-, | PB #PBLOW|C,4,0,-, | PS
#PVAC|C,4,0,-, |
```

Preview Hex	Preview Ascii
48 4C 20 30 31 20 48 54 20 32 32	HL 01 HT 22
20 20 20 20 20	DA 18/12
20 20 44 41 20 31 38 2F 31 32 20	TI 10:21
54 49 20 31 30	H 6.1
3A 32 31 20 48 20 20 20 36 2E 31	VA 0.2
20 56 41 20 20	PH 29.22
30 2E 32 20 50 48 20 20 32 39 2E	KF 1.10
32 32 20 4B 46	PB 1264
20 20 31 2E 31 30 20 50 42 20 31	PS 504
32 36 34 20 50	
53 20 20 35 30 34	

### Teleheader String without header (NEW)

```
HL #PL|C,2,0| HT #HN|S,8| DA #DATE|T,DD-MM-YY| TI #DATE|T,hh:mm| KF #KF|C,1,3|
DE #IMMDEPTH|C,3,0,-, | CT #CATHTMP|C,2,1,-, | PH #PH2|C,3,2,-, | H #H|C,2,1,-,
| VA#VAR|C,2,2,-, | HP #HC|C,2,1,-, | HC #PHB|C,3,2,-, | PB #PBLOW|C,4,1,-, | PS
#PVAC|C,4,1,-, |
```

Preview Hex	Preview Ascii
48 4C 20 30 31 20 48 54 20 32 32	HL 01 HT 22
20 20 20 20 20	DA 18-12-18
20 20 44 41 20 31 38 2D 31 32 2D	TI 10:21
31 38 20 54 49	KF 1.100
20 31 30 3A 32 31 20 4B 46 20 31	DE 11
2E 31 30 30 20	CT 25.8
44 45 20 20 31 31 20 43 54 20 32	PH 29.22
35 2E 38 20 50	H 6.1
48 20 20 32 39 2E 32 32 20 48 20	VA 0.19
20 20 36 2E 31	HP 00.0
20 56 41 20 30 2E 31 39 20 48 50	HC 000.00
20 30 30 2E 30	PB 1264.4
20 48 43 20 30 30 30 2E 30 30 20	PS 503.6
50 42 20 31 32	
36 34 2E 34 20 50 53 20 20 35 30	
33 2E 36	

### Calibration Telegram

```
DATE #DATE|T,DD/MM| TIME #DATE|T,hh:mm| CATHTEMP #CATHTMP|C,2,1,-, | CYCLE
#CAL_CYC|C,2,0| CALFACTOR #CAL_FAC|C,1,3,-, | H2HPA #CAL_H2HPA|C,3,2,-, | H2RES
#CAL_H2RES|C,2,3,-, | CERTGASVAL #CAL_GAS|C,2,3,-, | ALLOWEDDEV #CAL_AD|C,2,1,-,
| FILTER #FILTER|C,3,0| CALERROR #CAL_ERR|C,1,0|
```

Preview Hex	Preview Ascii
44 41 54 45 20 30 31 2F 30 31 20	DATE 01/01
54 49 4D 45 20	TIME 00:00
30 30 3A 30 30 20 43 41 54 48 54	CATHTEMP 00.0
45 4D 50 20 30	CYCLE 00
30 2E 30 20 43 59 43 4C 45 20 30	CALFACTOR 0.000
30 20 43 41 4C	H2HPA 000.00
46 41 43 54 4F 52 20 30 2E 30 30	H2RES 00.000
30 20 48 32 48	CERTGASVAL 00.000
50 41 20 30 30 30 2E 30 30 20 48	ALLOWEDDEV 00.0
32 52 45 53 20	FILTER 000
30 30 2E 30 30 30 20 43 45 52 54	CALERROR 0
47 41 53 56 41	
4C 20 30 30 2E 30 30 30 20 41 4C	
4C 4F 57 45 44	
44 45 56 20 30 30 2E 30 20 46 49	
4C 54 45 52 20	
30 30 30 20 43 41 4C 45 52 52 4F	
52 20 30	

### Leakage telegram

```
DATE #DATE|T,DD/MM| TIME #DATE|T,hh:mm| CATHTEMP #CATHTMP|C,2,1,-, | STARTPVAC
#LT_S_PVAC|C,4,0,-, | STARTPBLOW #LT_S_PBLOW|C,4,0,-, | PVACLOSS #LT_L_Pvac|
C,4,0,-, | PBLOWLOSS #LT_L_Pblow|C,4,0,-, | ENDPVAC #LT_E_Pvac|C,4,0,-, | ENDP-
BLOW #LT_E_Pblow|C,4,0,-, | MAXALLOWEDLOSS #LT_MAX_LOSS|C,4,0,-, | LEAKERR
#LT_ERR|C,1,0|
```

Preview Hex	Preview Ascii
44 41 54 45 20 30 31 2F 30 31 20	DATE 01/01
54 49 4D 45 20	TIME 00:00
30 30 3A 30 30 20 43 41 54 48 54	CATHTEMP 00.0
45 4D 50 20 30	STARTPVAC 0000
30 2E 30 20 53 54 41 52 54 50 56	STARTPBLOW 0000
41 43 20 30 30	PVACLOSS 0000
30 30 20 53 54 41 52 54 50 42 4C	PBLOWLOSS 0000
4F 57 20 30 30	ENDPVAC 0000
30 30 20 50 56 41 43 4C 4F 53 53	ENDPBLOW 0000
20 30 30 30 30	MAXALLOWEDLOSS 0000
20 50 42 4C 4F 57 4C 4F 53 53 20	LEAKERR 0
30 30 30 30 20	
45 4E 44 50 56 41 43 20 30 30 30	
30 20 45 4E 44	
50 42 4C 4F 57 20 30 30 30 30 20	
4D 41 58 41 4C	
4C 4F 57 45 44 4C 4F 53 53 20 30	
30 30 30 20 4C	
45 41 4B 45 52 52 20 30	

## 9.3.2 Industrial Protocols

### 9.3.2.1 Input

Choose between high byte or low byte first and then proceed.

**Table 28: Input telegrams for Profibus, Profinet, Ethernet IP and Modbus TCP**

Offset	Bytes	Variable Name	Type	Description
0	4	levelTwoFilterFlag	unsigned word 32	used bitwise
4	4	SetKfFactor	Float (32 bit)	The K/f factor of the last started measurement
8	20	SetHeatNo	ASCII characters	The heat number of the last started measurement. Left aligned, NULL terminated string
28	8	SetDate	ASCII characters	ddmmyyyy
36	4	SetTime	ASCII characters	HHMM
40	2	Life_Counter	unsigned int 16	PLC running indication
42	1	SetMeasurementMode	unsigned byte	

The input data send to the Hydris® instrument are managed as a single blob of all bytes which represents the input memory map of one place inside the communicator gateway. This blob requires flag settings at LevelTwoFilterFlag to indicate the required updates of data (update data selection).

The writing process has to take care about the status flags to check if input data are still in progress. This should help to avoid multiple writings in a too short time which may overload the communication between communicator gateway and the Hydris® software. Ideal writing cycles are >3 seconds e.g. 3 or 5 seconds delay.

The update rate between the gateway module and the Hydris® software is configured to one I/O per second (subnetwork update rate).



**Note:** Changes of input data during a measurement have no influence on this running measurement but will be stored and used for a later measurement.



bus

### 9.3.2.2 Output

Choose between high byte or low byte first and then proceed.

**Table 29: Industrial output telegram for Profibus, Profinet, Ethernet IP and Modbus TCP**

Offset	Variable Name	Type	Description
0	CALCERR_IND	Byte	Error code of the QuiK-Read measurement (Flush-B calculation)
1	EQUIERR_IND	Byte	Error code of the Equilibrium measurement
2	STATE	Byte	The internal state of the instrument
3	STATEDetail	Byte	Additional information when a measurement is active. Then STATE is 3, 11 or 13
4	TYPE	Byte	The type of last started measurement
5	ERR_IND	Byte	Final error code of the measurement
6	HC	Float	The calculated hydrogen level result of a QuiK-Read measurement
10	PHB	Float	The calculated partial pressure result of a QuiK-Read measurement
14	CATHTMP_LIVE	Float	Temperature of the catharometer of each sample during a measurement
18	H	Float	Hydrogen level result of an equilibrium measurement.
22	PH2	Float	The partial pressure result of an Equilibrium measurement
26	FILTER	Int	The filter count that indicates how many measurements have been performed with the installed humidity filter on the pneumatic unit
30	IMMDEPTH	Float	The immersion depth of the probe. Depends on a parameter in the instrument. If a fixed immersion depth is used, this value will be used in this variable. If the immersion depth is being evaluated, the evaluated value will be used in this variable.
34	KF	Float	The K/f factor of the last started measurement
38	DATE	String	The date and time of the last started measurement (local system time)
44	DATE	String	
52	HUMIDTY_LIVE	Float	The relative humidity of the carrier gas of each sample during a measurement
56	PBLOW	Float	The blow pressure of each sample during a measurement
60	PH2_LIVE	Float	The partial pressure (PH2) of each sample during a measurement
64	PVAC	Float	The vacuum pressure of each sample during a measurement
68	VAR	Float	The hydrogen level variation during the plateau window of the hydrogen level result (H)

**Table 29: Industrial output telegram for Profibus, Profinet, Ethernet IP and Modbus TCP**

Offset	Variable Name	Type	Description
72	WATCHDOG	Short	A watchdog counter that is incremented every second
74	INPUTPROCESSFLAGS	Int	This variable signals the current progress of the input data handling using bit flags. The flags only apply to data received via Level2, not the UI.
78	HN	String	The heat number of the last started measurement
98	PD	String	The description of the place that started the last measurement

Address	Size	Type	Variable	Value	Description
0	1	Byte	CALCERR_IND	0	
1	1	Byte	EQUERR_IND	0	
2	1	Byte	STATE	3	
3	1	Byte	STATEDETAIL	20	
4	1	Byte	TYPE	0	
5	1	Byte	ERR_IND	0	
6	4	Float	HC	NAN	
10	4	Float	PHB	NAN	
14	4	Float	CATHIMP_LIVE	26.8125	
18	4	Float	H	4.141417	
22	4	Float	PH2	28.52774	
26	4	Int	FILTER	39	
30	4	Float	IMMDEPTH	10.79177	
34	4	Float	KF	0.75	
38	6	String	DATE	135237	
44	8	String	DATE	14012019	
52	4	Float	HUMIDIFY_LIVE	23.8	
56	4	Float	PBLow	1273.45	
60	4	Float	PH2_LIVE	29.51878	
64	4	Float	PVAC	516.85	
68	4	Float	VAR	0.1630858	
72	2	Short	WATCHDOG	128	
74	4	Int	INPUTPROCESSFLAGS	0	
78	20	String	HN	000000010000000000000000	
98	20	String	PD	HydrisPU0000000000000000	

**Figure 27:** Example of Industrial Output for Profibus

## 9.4 Telegram Construction

In general there are three types of output: free text, control characters and variables.

### 9.4.1 Free text

Free text is allowed in telegram definitions. Just type the text you want to output. There is however one exception. The character # is not allowed in free text because it is used to distinguish placeholders from free text. If you want this character in the output, use the control character placeholder (see next paragraph).

In industrial telegrams you can insert empty spaces with no functionality just to register reservations. Syntax: #\*X with X is the number of bytes you wish to insert.

### 9.4.2 Control characters

The control character placeholder is used to output a specified ASCII character. The purpose is to output characters that are not typeable (ex. STX, ETX, LF...), but it is also possible to output typeable character such as 1, 2, 3, or A, B, C.

Format: # $\$XX$

```
Example: # $ODDATE:
```

The *xx* should be replaced with the hexadecimal code from the character you would like to output. The hexadecimal value can be found in an [ASCII table](#).

## 9.4.3 Variables

They all have the same base syntax:

```
#var |x|
```

The *var* should be replaced with the name of the variable you want to output. These variables will be defined by the instrument.

The *x* will define how you output the selected variable:

- *#var |B|*: the variable must be output as an unsigned byte.  
If not applicable or error output: 0x00
- *#var |I,x,y,z|*, where *y* tells you to multiply or divide by *z* and *z* is the value of the multiplier or divider.
- *#var |D,x|*, *#var |F,x|*: the variable will be output as a signed 2 byte integer resp. 4 byte integer or 4 byte floating point.  
The *x* indicates the byte order: H = high byte first and L = low byte first.  
If not applicable or error output: 0x00 00 resp 0x00 00 00 00 resp 0xFF FF FF FF
- *#var |C,u,v,w,x|*: the variable will be output as a character with fixed decimal separator.

u	the amount of digits before the decimal separator (including the sign character if present)
v	the amount of digits after the decimal separator
w	sign character
x	prefix

Example:

```
# $ODK/f: #KF|C,2,3,-, |
```

```
output: K/f: 1.100
```

- `#var |C,F, y, z,w,x|`: the variable will be output as a character with floating decimal separator

y	the total amount of digits (including the sign character if present)
z	the maximum amount of digits after the decimal separator
w	sign character
x	prefix

The error character is fixed “F” and the not applicable character “0”

- `#var |S, x, y, z|`: the variable will be output as a string.

x	total length of the output text
y	alignment parameter (L = left, R = right)
z	filling character (hexadecimal ASCII code)

If not applicable the filling character is shown x times.

- `#var |T, x...x|`: the variable will be formatted as a Date/Time and output as an ASCII byte series.

Example:

```
#$ODDATE: #DATE|T,DD-MM-YY|
output: DATE: 18-12-18
```

- `#var |T, UNIX, x|`: the variable will be formatted as a Date/Time and output as a byte series that represent a couple of numerical values.

The x indicates the byte order: H = high byte first and L = low byte first.

The following paragraph gives the list of variables used in the Hydris® system.

## 9.4.4 Level2 variables

**Table 30: Available variables for telegrams**

Variable name	Description	Data type
CALCERR and CALCERR_IND	Error code of the QuiK-Read measurement (Flush-B calculation) (see different error codes below)	Unsigned byte
FCALCERR	Flag for CALCERR and CALCERR_IND	Unsigned byte
CAL_CYC	The total amount of calibration cycles performed during a calibration	32 bit unsigned integer
CAL_FAC	A system dependent calibration constant	32 bit floating point
CAL_H2HPA	The amount of directly measured hydrogen	32 bit floating point
CAL_H2RES	The amount of hydrogen measured using the calibration factor	32 bit floating point
CAL_GAS	The certified value of the calibration gas used to perform the calibration	32 bit floating point
CAL_AD	The value by which the result may deviate from its nominal value	32 bit floating point
CAL_ERR	Error flag for the calibration process	Unsigned byte
CATHTMP	Temperature of the catharometer	32 bit floating point

**Table 30: Available variables for telegrams**

Variable name	Description	Data type
CATHTMP_LIVE	Temperature of the catharometer of each sample during a measurement	32 bit floating point
DATE	The date and time of the last started measurement (local system time)	DateTime
DATE_PLC.UTC	The UTC date of the last started measurement represented as a count of days since 1 January 1990	DateTime
DATE.UTC	The date and time of the last started measurement (UTC time)	DateTime
EQUIERR and EQUIERR_IND	Error code of the Equilibrium measurement (see different error codes below)	Unsigned byte
FEQUIERR	Flag for EQUIERR and EQUIERR_IND	Unsigned byte
ERR and ERR_IND	Final error code of the measurement (see different error codes below)	Unsigned byte
FERR	Flag for ERR and ERR_IND	Unsigned byte
ERRORS	Combination of CALCERR, EQUIERR and ERR, and their flags	32 bit unsigned integer
FCALCERR	Flag for CALCERR and CALCERR_IND	Unsigned byte
FEQUIERR	Flag for EQUIERR and EQUIERR_IND	Unsigned byte
FERR	Flag for ERR and ERR_IND	Unsigned byte
FHBELOWMIN	Flag that indicates if the hydrogen level result of a successful measurement is below the minimum limit	Unsigned byte
FILTER	The filter count that indicates how many measurements have been performed with the installed humidity filter on the pneumatic unit	32 bit unsigned integer
H	The hydrogen level result of an Equilibrium measurement	32 bit floating point
HC	The calculated hydrogen level result of a QuiK-Read measurement	32 bit floating point
HN	The heat number of the last started measurement	ASCII characters
HUMIDITY	The relative humidity of the carrier gas used in the last measurement	32 bit floating point
HUMIDITY_LIVE	The relative humidity of the carrier gas of each sample during a measurement	32 bit floating point
IMMDEPTH	The immersion depth of the probe. Depends on a parameter in the instrument. If a fixed immersion depth is used, this value will be used in this variable. If the immersion depth is being evaluated, the evaluated value will be used in this variable.	32 bit floating point
INPUTPROCESSFLAGS	This variable signals the current progress of the input data handling using bit flags. The flags only apply to data received via Level2, not the UI. (see different codes below)	32 bit unsigned integer
KF	The K/f factor of the last started measurement	32 bit floating point
LT_S_PVAC	The Pvac pressure during the start of a leakage test after pressure has stabilized	32 bit floating point
LT_S_PBLOW	The Pblow pressure during the start of a leakage test after pressure has stabilized	32 bit floating point
LT_L_PVAC	The amount of pressure lost during a leakage test on the Pvac line	32 bit floating point
LT_L_PBLOW	The amount of pressure lost during a leakage test on the Pblow line	32 bit floating point
LT_E_PVAC	The pressure on the Pvac line after performing a leakage test	32 bit floating point
LT_E_PBLOW	The pressure on the Pblow line after performing a leakage test	32 bit floating point
LT_MAX_LOSS	The maximum allowed pressure loss during a leakage	32 bit floating point
LT_ERR	Error flag for the calibration process	32 bit floating point
PBLOW	The blow pressure of each sample during a measurement	32 bit floating point
PD	The description of the place that started the last measurement	ASCII characters
PH2	The partial pressure result of an Equilibrium measurement	32 bit floating point
PH2_LIVE	The partial pressure (PH2) of each sample during a measurement	32 bit floating point

**Table 30: Available variables for telegrams**

Variable name	Description	Data type
PHB	The calculated partial pressure result of a QuiK-Read measurement	32 bit floating point
PL	The number of the place that started the last measurement	Unsigned byte
PVAC	The vacuum pressure of each sample during a measurement	32 bit floating point
STATE	The internal state of the instrument (see different state codes below)	Unsigned byte
STATEDetail	Additional information when a measurement is active. Then STATE is 3, 11 or 13 (see different state detail codes below)	Unsigned byte
TIME_PLC_UTC	The UTC time of the last started measurement represented as a count of milliseconds since midnight	32 bit unsigned integer
TYPE	The type of last started measurement (see different measurement type codes below)	Unsigned byte
VAR	The hydrogen level variation during the plateau window of the hydrogen level result (H)	32 bit floating point
WATCHDOG	A watchdog counter that is incremented every second	16 bit unsigned integer

**Table 31: QuiK-Read measurement error codes**

CALCERR	CALCERR_IND	Description
0	0	No error
1	100	Hydrogen level from QuiK-Read calculation is below minimum
2	101	No stable plateau found during Flush-B during QuiK-Read calculation

When a new measurement starts, the variable is set to No error. When an error occurs during a QuiK-Read measurement, the appropriate error code will be assigned.

QuiK-Read measurement error flag (FCALCERR) is updated every time CALCERR is updated (0: no calculation error, 1: calculation error present).

**Table 32: Equilibrium measurement error codes**

EQUIERR	EQUIERR_IND	Description
0	0	No error
1	201	Hydrogen level exceeds the maximum limit
2	202	Hydrogen level drops permanently below/equal to zero
3	203	Pressure tube blockage ( $P_{\text{blow}}$ blocked)
4	204	Vacuum pressure below minimum limit ( $P_{\text{vac}}$ too low)
5	205	Vacuum pressure above maximum limit ( $P_{\text{vac}}$ too high)
6	206	Measurement timeout (too long measurement)
7	207	Hydrogen level during Equilibrium does not fit Flush-B level
8	208	Vacuum pressure rises above conditions during measurement

When a new measurement starts, the variable is set to No error. When an error occurs during an equilibrium measurement, the appropriate error code will be assigned.

Equilibrium measurement error flag (FEQUIERR) is updated every time EQUIERR is updated (0: no equilibrium error, 1: equilibrium error present).

**Table 33: Measurement error codes**

ERR	ERR_IND	Description
-	0	Measurement is active
0	1	No error
1	2	Aborted by user
2	3	Immersion timeout
3	4	Not supported
4	5	Pressure sensor error
5	6	No TCD calibration data found on pneumatic unit
6	7	No PIC/TIC data found on pneumatic unit
7	8	No carrier gas detected or probe detection failure
8	9	Unstable TCD signal during zero setting. Cannot proceed zero setting.
9	10	TCD drift outside limits after zero setting
10	11	Pressure tube blocked during Flush-A ( $P_{blow}$ too high)
11	12	Vacuum tube blocked during Flush-B ( $P_{vac}$ too high)
12	13	Hydrogen level too high during Flush-B
13	14	Pressure tube blocked during Flush-B ( $P_{blow}$ too high)
14	15	A QuiK-Read or Equilibrium error has occurred. Check CALCERR and EQUIERR for more details.
15	16	not supported
16	17	Vacuum pressure too high
17	18	Measurement canceled because last leakage test was not successful

When a new measurement starts, the variable is set to No error. When an error occurs, the appropriate error code will be assigned.

The measurement error flag (FERR) is updated every time ERR is updated (0: measurement ended successfully, 1: measurement ended with error).

**Table 34: Combined errors**

Variable name	Description
Description	Combination of CALCERR, EQUIERR and ERR, and their flags
Data type	32 bit unsigned integer
Format	[byte4] [byte3] [byte2] [byte1] [FLAGS] [CALCERR] [EQUIERR] [ERR]

The composition of FLAGS is:

FLAGS = [bit8] [bit7] [bit6] [bit5] [bit4] [bit3] [bit2] [bit1]

FLAGS = [0] [0] [0] [0] [0] [FCALCERR] [FEQUIERR] [FERR]

**Table 35: Measurement type codes**

Type code	Description
0	Hydris or HydroVAS measurement
1	Air test measurement
2	Test gas measurement
3	Leakage test
4	Calibration

**Table 36: System state codes**

State code	Description
0	no pneumatic unit connected
1	pneumatic unit connected
2	standby
3	measurement active
4	preparation for leakage test
5	leakage test active
8	preparation for calibration
9	calibration active
10	preparation for air test measurement
11	air test measurement active
12	preparation for test gas measurement
13	test gas measurement active
14	manual access active

The variable is updated continuously.

**Table 37: System state detail codes**

State detail code	Description
0	-
1	measurement init step 1
2	measurement init step 2
3	air pressure detection
4	probe detection step 1
5	probe detection step 2
6	probe detection step 3
7	zero setting step 1
8	zero setting step 2
9	zero setting step 3
10	zero setting step 4
11	zero setting step 5
12	zero setting step 6

**Table 37: System state detail codes**

State detail code	Description
13	ready to measure
14	flush-A
15	flush-B step 1
16	flush-B step 2
17	equilibrium measurement
18	aborted by the user
19	measurement ended prematurely because of error
20	purgings
21	measurement ended successfully

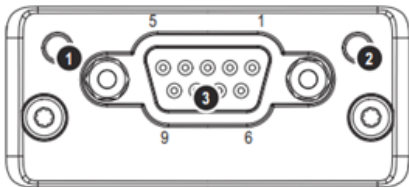
**Table 38: Input process status feedback (INPUTPROCESSFLAGS)**

Bit representations	Description
0	handling new K/f factor
1	handling new heat number
2	handling new date
3	handling new time
4	handling new measurement mode
5-15	not used
16	error while handling new K/f factor
17	error while handling new heat number
18	error while handling new date
19	error while handling new time
20	error while handling new measurement mode

## 10. Optional in- or outputs

**!** **CAUTION:** Maximum 2 Anybus options can be connected.

### 10.1 Connections for Profibus



1	communication LED
2	device status LED
3	Profibus connector

**Table 39: Profibus Connector (DB9F)**

Pin	Function	Pin	Function
1	Not connected	2	Not connected
3	B+	4	RTS (request to send)
5	DGND	6	V (+5V)
7	Not connected	8	A-
9	Not connected		

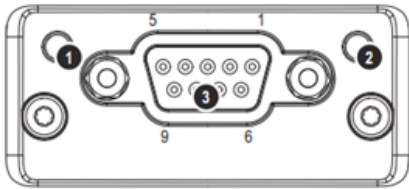
**Table 40: Profibus Communication LED**

State	Description
Off	Not online/No power
Green	Data exchange
Flashing Green	Clear
Flashing red (1 flash)	Parameterization error
Flashing red (2 flashes)	PROFIBUS Configuration error

**Table 41: Profibus Device Status LED**

State	Description
Off	Not initialized
Green	Initialized
Flashing Green	Initialized, diagnostic event(s) present
Red	Exception error

## 10.2 Connections for Modbus



<b>1</b>	communication LED
<b>2</b>	device status LED
<b>3</b>	Profibus connector

**Table 42: Modbus Connector (DB9F)**

Pin	Function	Pin	Function
1	GND	2	5V
3	PMC	4	not connected
5	RS-485B-line	6	not connected
7	RS-232 Rx	8	RS-232 Tx
9	RS-485 A-line		

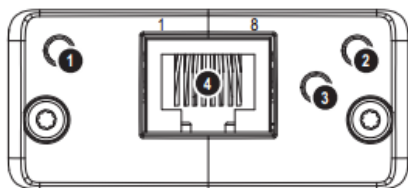
**Table 43: Modbus Communication LED**

State	Description
Off	No power or no traffic
Yellow	Frame reception or transmission
Red	A fatal error has occurred

**Table 44: Modbus Device Status LED**

State	Description
Off	Initializing or no power
Green	Module initialized, no error
Red	Internal error or major unrecoverable fault
Red, single flash	Communication fault or configuration error Case 1= Invalid settings in Network Configuration Object Case 2= Network Configuration Object settings have been changed during runtime
Red, double flash	Application diagnostics available

## 10.3 Connections for Ethernet/IP



1	Network Status LED
2	Module Status LED
3	Link/Activity
4	Ethernet Interface

**Table 45: Network status LED Ethernet connector**

State	Description
Off	No power or IP address
Green	Online, one or more connections established
Green flashing	Online, no connections established
Red	Duplicate IP address, FATAL error
Red flashing	One or more connections timed out

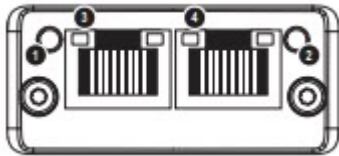
**Table 46: Module status LED Ethernet connector**

State	Description
Off	No power
Green	Controlled by a scanner in operational state
Green flashing	Not configured, or scanner in idle state
Red	Major fault (Exception state, fatal error state)
Red flashing	Recoverable fault(s)

**Table 47: LINK/Activity LED Ethernet connector**

State	Description
Off	No link, no activity
Green	Link established
Green flashing	Activity

## 10.4 Connections for Modbus TCP



1	Network Status LED
2	Module Status LED
3	Link/Activity Port 1
4	Link/Activity Port 2

**Table 48: Network status LED Modbus TCP connector**

State	Description
Off	No power or no IP address
Green	Module is in Process Active or Idle state
Green flashing	Waiting for connections
Red	Duplicate IP address or FATAL error
Red flashing	Process Active Timeout

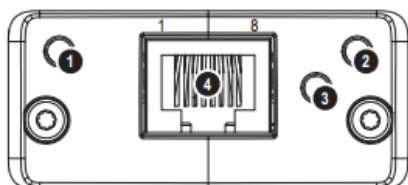
**Table 49: Module status LED Modbus TCP connector**

State	Description
Off	No power
Green	Normal operation
Red	Major fault, module is in state exception or fatal event
Red flashing	Minor fault in diagnostic object, IP conflict

**Table 50: LINK/Activity LED Modbus TCP connector**

State	Description
Off	No link, no activity
Green	Link established, 100 Mbits/s
Green flashing	Activity, 100 Mbits/s
Yellow	Link established, 10 Mbits/s
Yellow flashing	Activity, 10 Mbits/s

## 10.5 Connections for Profinet IO



1	Network Status LED
2	Module Status LED
3	Link/Activity
4	Ethernet Interface

**Table 51: Network status LED Profinet IO connector**

State	Description
Off	Offline: no power, no connection with IO controller
Green	Online: connection with IO controller established, IO controller in RUN state
Green flashing	Online: connection with IO controller established, IO controller in STOP state

**Table 52: Module status LED Profinet IO connector**

State	Description
Off	Not initialized
Green	Normal operation
Green, 1 flash	Diagnostic Event(s)
Green, 2 flashes	Blink
Red	Exception Error

**Table 52: Module status LED Profinet IO connector**

State	Description
Red, 1 flash	Configuration Error
Red, 2 flashes	IP Address Error
Red, 3 flashes	Station Name Error
Red, 4 flashes	Internal Error

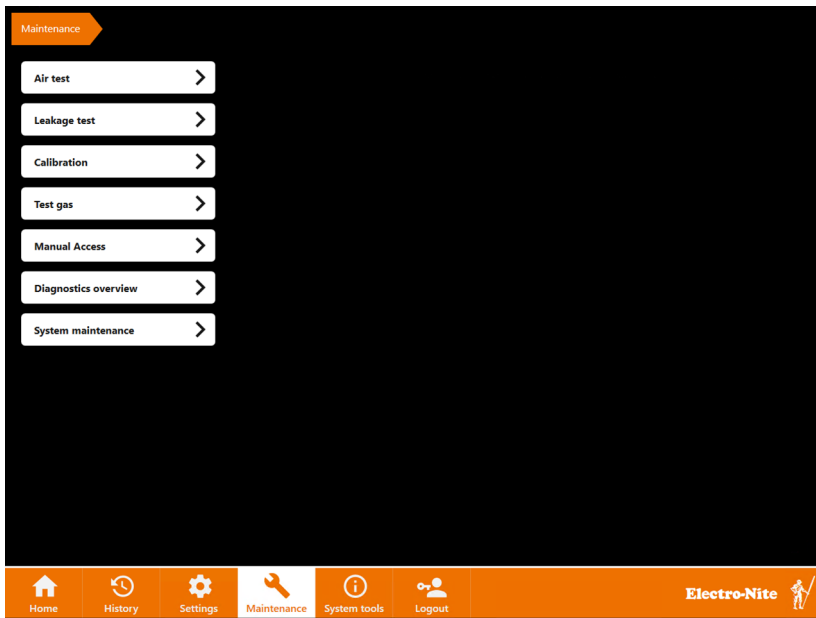
**Table 53: LINK/Activity LED Profinet IO connector**

State	Description
Off	No link, no activity
Green	Link established
Green flashing	Activity

# 11. Maintenance

## 11.1 Maintenance screen

Several maintenance actions are possible in the maintenance tab.



**Figure 28:** Maintenance screen

Maintenance action	User level	Paragraph
Air test	Operator	11.5
Leakage test	Engineer	11.6
Calibration	Service Engineer	11.7
Test gas	Service Engineer	11.8
Manual access	Engineer	11.9
Diagnostics overview	Engineer	11.10
System maintenance	Operator	11.12

The system is locked whilst performing any of the above maintenance functions.

## 11.2 Maintenance plan

Frequency	Who	Type	Results
Daily	Operator	Air test	1.2ppm < H < 1.6ppm <sup>1</sup> Psu(Pvac) > 730hPa <sup>1</sup>
		Control of filter leak	Leak < 25hPa <sup>1</sup>
Weekly	Operator	Verify Hydris® checkbook	
		Verify Hydris® parameters	
		Leakage test	Leak < 15hPa <sup>2</sup>
		Control of filter	Filter > 300 measurements? <sup>3</sup>
		Mechanical/visual control of pneumatic hose/lance	
3-monthly (low ppm)	Service engineer	Verify Hydris® checkbook	
		Verify Hydris® parameters	
6-monthly (high ppm)	Service engineer	Air test <sup>4</sup>	1.2ppm < H < 1.6ppm Psu(Pvac) > 730hPa
		Leakage test	Leak < 15hPa <sup>2</sup>
		Control of filter	Filter > 300 measurements? <sup>3</sup>
		Calibration and calibration check	Depended on the calibration gas
		Mechanical/visual control of pneumatic hose/lance	Stable zerosetting <sup>5</sup>

1 see Hydris® checkbook

2 Leak should be repaired as soon as values over 15 are found (preventive action)

3 Depending on application

4 The Air Test measurement has to be performed 6-monthly to meet the instrument warranty.

5 Green light: 5 minute wait. Restart: 5 minute wait. No zerodrift failure: OK

The following shows an example Hydris® checkbook:

**Table 54: Example Hydris® checkbook**

Date	Shift	Operator	ppm	Psu	Leak Test	Filter No.	Remarks
19 Nov	Red	Simon	1.4	767	6	23	
	Green	Gregor	1.3	772	5	43	
	Blue	Adam	1.4	766	4	5	Filter changed
20 Nov	Red	Simon	1.4	732	4	27	
	Green	Gregor	1.2	690	6	45	
	Blue	Adam	1.1	550	5	67	p
	Maintenance	Joseph	1.4	790	3	1	Hose blocked? New hose and filter
21 Nov							
22 Nov							

## 11.3 Maintenance kit

The maintenance kit contains spare parts for the system and tools for leak detection, system calibration, and lance repair.

You are advised to order a maintenance kit when ordering the system. The lack of correct maintenance tools makes a correct diagnosis of the system impossible.



**Note:** A few tools in the maintenance kit are for the Nitris system, which are not required when maintaining the system.

**Table 55: Overview of maintenance and spare parts sets**

Set	Item	Use	Quantity	Packaging
1	Quick-Coupling diameter 4mm	Blow tube lance	1	Plastic box
	Quick-Coupling diameter 6mm	Vacuum tube lance	1	Plastic box
2	Allen screw M10*10	Handle lance	10	Plastic box
	Allen screw M5*8	Pneumatic hose plug Leak tool lance	20	Plastic box
	O-ring 24.5*3	Nitris furnace	20	Plastic box
	O-ring 4.47*1.87	Pneumatic hose plug Calibration tool Nitris furnace plug	50	Plastic box
	O-ring 23.52*1.78	Pneumatic hose plug Pneumatic unit leak tool Calibration gas supply tool	50	Plastic box
	O-ring 12.43*1.78	Leak tool lance	50	Plastic box
	Bulb 130V 2.4W	Control lights pneumatic units	3	Plastic box
	3	Fuse 2A FF	Pneumatic unit	30
Fuse 1A FF		Pneumatic unit Nitris	10	Plastic box
Fuse 10A MT		Nitris furnace	10	Plastic box
Fuse 6.3A MT		Pneumatic unit	10	Plastic box
Fuse 2.5A MT		Processor-Pneumatic unit	10	Plastic box
Fuse 1.25A MT		Processor-Pneumatic unit	10	Plastic box
4 (tools for leak detection and air test)	Leak detection tool	Lance test	1	Separate
	Leak detection tool	Pneumatic hose test	1	Separate
	Leak detection tool	Pneumatic unit test	1	Separate
	Air simulation tool	Lance test	1	Separate
	Gas supply tool	Hydris® calibration	1	Separate
5 (calibration set supply tool)	Allen key 2.5mm	Allen screw M5*8	1	Separate

**Table 55: Overview of maintenance and spare parts sets**

Set	Item	Use	Quantity	Packaging
6 (tools for lance repair)	Allen key 5mm	Allen screw M10*10	1	Separate
	Tube deburring tool	Gas tubes lance	1	Separate
	Copper tube cutter	Gas tubes lance	1	Separate
	Key 12	Quick-Couplings diameter 4mm	1	Separate
	Key 14	Quick-Couplings diameter 6mm	1	Separate
	Crimp contact removal tool	Interface cable Hydris®	1	Separate
	Crimp contact (male)	Interface cable Hydris®	20	Separate
	Crimp contact (female)	Interface cable Hydris®	20	Separate

Contact your local Heraeus Electro-Nite representative for the order numbers.

## 11.4 Daily maintenance procedure

It is sufficient to carry out an air simulation test and a leak test to check the performance of the Hydris® system. If both tests are positive, the Hydris® system is working well. The data obtained by the air simulation indicates whether the calibration is still within acceptable limits.



**Note:** Very accurate hydrogen readings can only be ensured if the Hydris® system is calibrated at least once every three months.

Before checking the functioning of the system, ensure that all connections are correctly made and prepare the tools in the maintenance kit:

- Leak tools for lance, hose, and system
- Calibration tool

Assuming the nitrogen supply is at 5 bar, power is on, and the interface cable is connected:

- 1 Start an air test ( 11.5 )  
1.2 ppm < H < 1.6 ppm  
If not OK take necessary action.
- 2 Start a leakage test ( 11.6 )  
Leak < 15 hPa  
If not OK take necessary action.

## 11.5 Air test

The purpose of an air test measurement is to check the correct functioning of the system and to detect blockages in the gas circuit.


**Before you begin:**

**Conditions:**

- Ensure all connections are correctly made.
- Nitrogen gas is available.
- The probe is fully removed from the lance to ensure good air circulation.

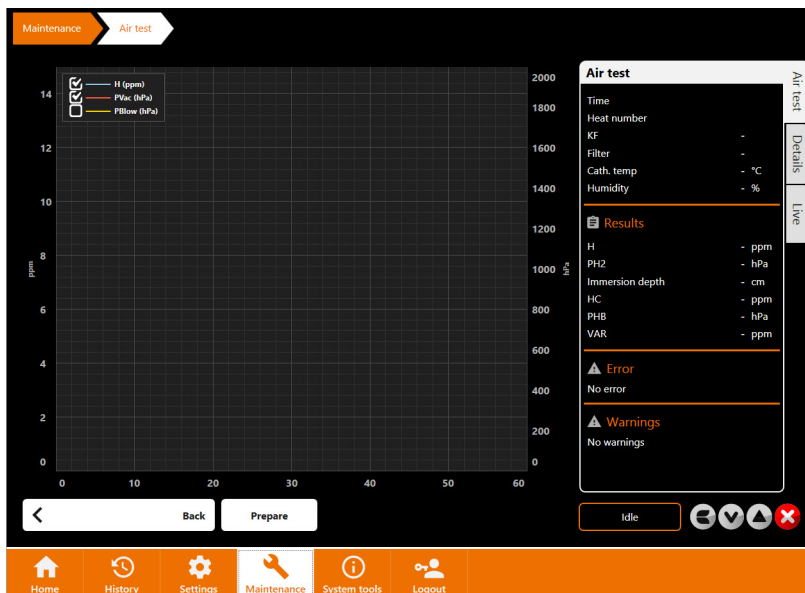
**Personnel:****Number of workers:** 1**Category:** operator

- 1 Start the air test measurement.  
The measured value is between 1.2 ppm and 1.6 ppm. Air test OK. Stop testing.  
If value not OK, start a new air test.
- 2 Start a new air test.  
The measured value is between 1.2 ppm and 1.6 ppm. Air test OK. Stop testing.  
If value not OK, replace the filter.
- 3 Replace the filter and start a new air test.  
The measured value is between 1.2 ppm and 1.6 ppm. Air test OK. Stop testing.  
If value not OK, check whether certified nitrogen gas was used.
- 4 Recalibrate the system and run a new air test.

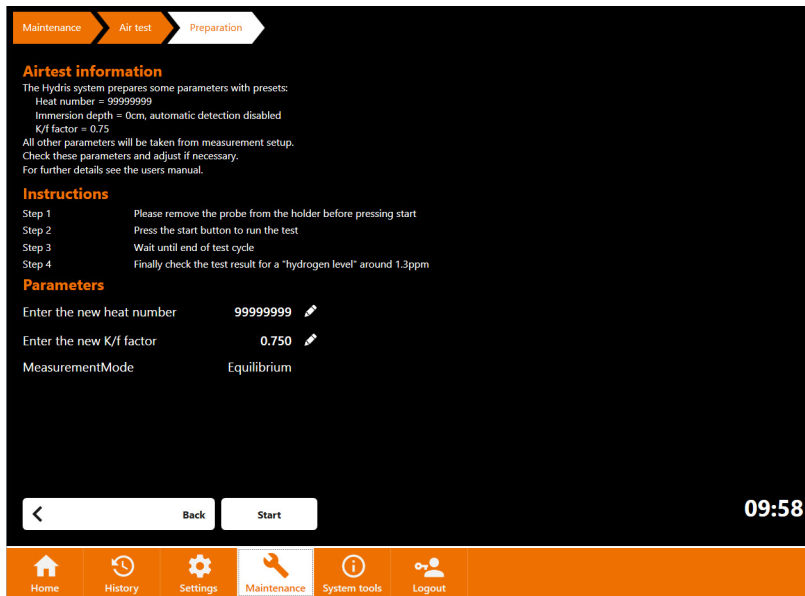
 **Note:** Use certified nitrogen gas to recalibrate the system.

## 11.5.1 Running an air test

- 1 On the maintenance screen, click **Air test**.
- 2 The result of the last air test will be shown. Click **Prepare** to initiate the air test.



- 3 Configure the air test setting.



- 4 Click **Start** to start the air test.
- 5 The air test will start and show the result at the end.

## 11.6 Leakage test

The leak test checks that the complete system (pneumatic unit, hose, and lance) has no leaks. Leakages result in inaccurate measurements.

### Before you begin:

#### Conditions:

- Ensure all connections are correctly made.
- Ensure nitrogen gas is available.

#### Personnel:

**Number of workers:** 1

**Category:** Operator

**Equipment:**

- The leak test tool for the lance (right) can be identified by its large o-ring (see connector in the middle). Lock it by fixing the screw of the cylindrical tube (on the left).



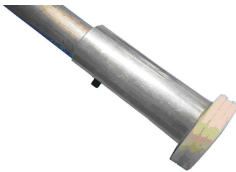
- leak tool for the pneumatic hose.



- leak tool for the pneumatic unit

**Safety:**

- 1 Check regularly for leakage of nitrogen. Leakage of nitrogen can displace the oxygen in the air in an almost closed environment. This can result in a dangerous situation for the operator.
- 1 Connect the leak test tool to the lance. It must remain on the lance until the end of the leak test, which is different to the air simulation tool.



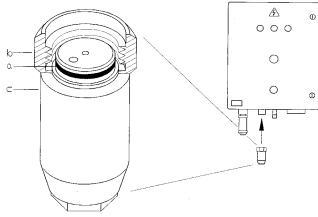
- 2 Run a leakage test ( 11.6.1 )

- No leakage detected: remove the leak tool, system OK
- Leakage detected: remove the leak tool from the lance, repair the lance if needed or check the o-ring in the leak tool, and connect the leak tool to the pneumatic hose, then go to 3.



### 3 Run a new leakage test ( 11.6.1 )

- No leakage detected: remove the leak tool, system OK
- Leakage detected: remove the leak tool from the pneumatic hose, repair the pneumatic hose if needed, connect the leak tool to the pneumatic unit, then go to 4. This leak tool contains a large O-ring (a) that can be replaced when unlocking the Allen screw (b).



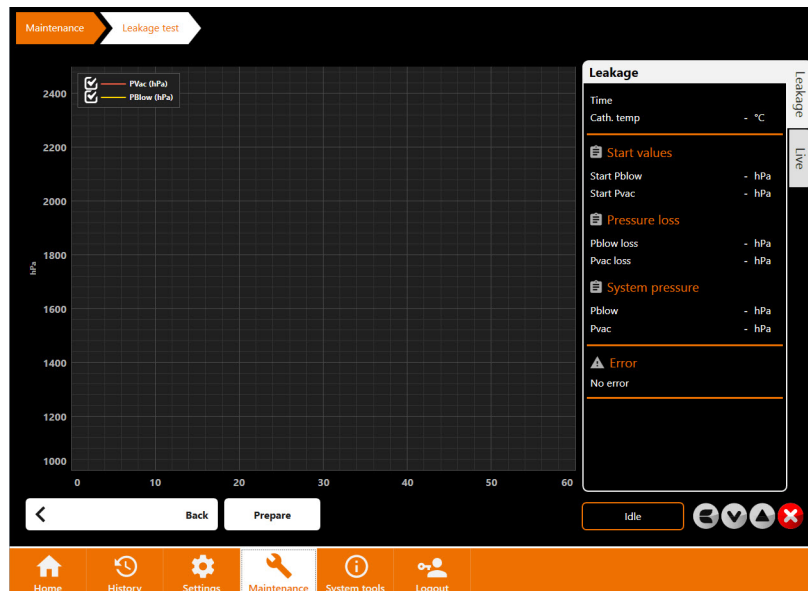
### 4 Run a new leakage test ( 11.6.1 )

- No leakage detected: remove the leak tool, system OK
- Leakage detected: pneumatic system leaking.
  - Contact your local Heraeus Electro-Nite sales representative.

## 11.6.1 Run a leakage test

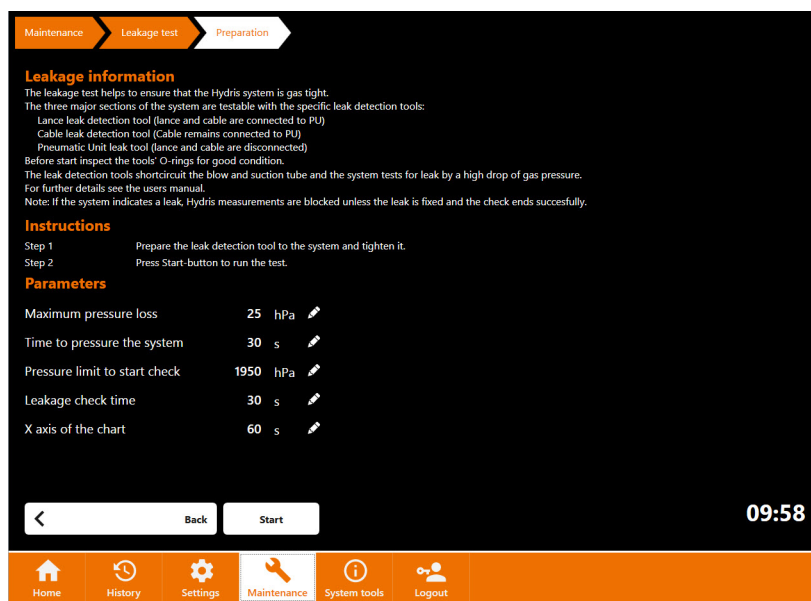
- 1 Log in with the engineer password
- 2 Select **Leakage test** on the maintenance screen.

The result of the last leakage test is shown.



- 3 Click **Prepare** to initiate a new leakage test.

#### 4 Configure the parameters for the leakage test.



#### 5 Click **Start** to start the leakage test.

The new result is shown at the end of the test.

## 11.6.2 Leakage test results

The leakage test can have one of the following results:

- 1 No leakage: system OK
- 2 Leakage found and message displayed at the end of test
- 3 Very large leakage found
- 4 Message displayed indicating that valves should be checked

If a leakage is detected the leak can be in the lance, pneumatic hose or pneumatic system. Sometimes the leak is so large that the system cannot even build up sufficient pressure to start the leakage test (case 3). Or during the leakage test the pressure keeps slowly rising after the valves are switched off. This indicates there is a small leak in one of the valves (case 4). In that case the defective valve must be replaced.

When looking for leaks, check the following items:

**Table 56: Checklist leak detection**

Origin of the leak	Item to check	Action
Lance	quick couplings	Check for loose couplings. If not loose, replace the couplings or copper tubes
Pneumatic hose	O-ring	Replace the large O-ring <sup>1</sup> If the problem persists, use a new hose.
Pneumatic system	filter	Replace the large O-ring <sup>1</sup> If the problem persists, use a new filter.
	pneumatic unit components	Contact your local Heraeus Electro-Nite sales representative.

<sup>1</sup> spare O-rings are available in the maintenance kit

## 11.6.3 Influence of leaks

The next table summarizes the influence of leaks on the measurement and which actions should be taken depending on the result of the leakage test.

**Table 57: Influence of leaks on the measurement results**

Result of leak test	Action	Influence on the measurement	Contact Heraeus Electro-Nite
leak < 15 hPa	System OK. Proceed with measurement.	None	No
15 hPa < leak < 25 hPa	System OK. Try to decrease this value. Potential danger on increasing leakage. Preventive actions are advised.	None	No
25 hPa < leak < 40 hPa	No measurement possible without modifying the leak limit in the parameter. Try to find the location of leak and repair.	Limited Risk on faulty measurements	Yes, if the problem is in the pneumatic unit
40 hPa < leak	No measurement possible without modifying the leak limit in the parameter. Try to find the location of leak and repair.	Large Theoretically, measurement still possible No guarantee on reliability of the result	Yes, if the problem is in the pneumatic unit
leak < -25hPa	Valves are defective. Replace the leaking valve. Measurement possible.	No measurement possible	Yes, if the problem is in the pneumatic unit

## 11.7 Calibration

### Before you begin:

#### Conditions:

- Ensure that all connections are correctly made.
- Use a new filter.
- Perform an air simulation ( 11.5 ) and leakage test ( 11.6 ) before calibration to ensure that the system performs well and is free of leaks.

#### Personnel:

**Number of workers:** 1

**Category:** Heraeus Electro-Nite engineer

**Equipment:**

- Calibration tool:
- Calibration gas:
  - the optimal pressure is 1000 hPa total pressure, it should not exceed 1500 hPa (or 500 hPa relative pressure).
  - the hydrogen content of the nitrogen mixture should be in the range of the maximum hydrogen level that can be expected. In the parameters, be sure that you select the certified composition of the bottle.
    - Example:
      - requested composition: 10.00 vol% hydrogen
      - certified composition: 10.23 vol% hydrogen
      - For the calibration use 10.23 in the parameters
  - The thermal conductivity of the hydrogen/nitrogen mixture is directly correlated to the hydrogen/nitrogen percentage. The following table shows the hydrogen contents of the H/N gas mixtures with the corresponding hydrogen values in steel.

Hydrogen content (%) bottle	Corresponding ppm H
1%	2.4
2%	3.4
3%	4.1
4%	4.7
5%	5.3
6%	5.8
7%	6.3
8%	6.7
9%	7.1
10%	7.5
12%	8.2
15%	9.2



**CAUTION:** Check regularly for leakage of nitrogen. Leakage of nitrogen can displace the oxygen in the air in an almost closed environment. This can result in a dangerous situation for the operator.

**Procedure:**

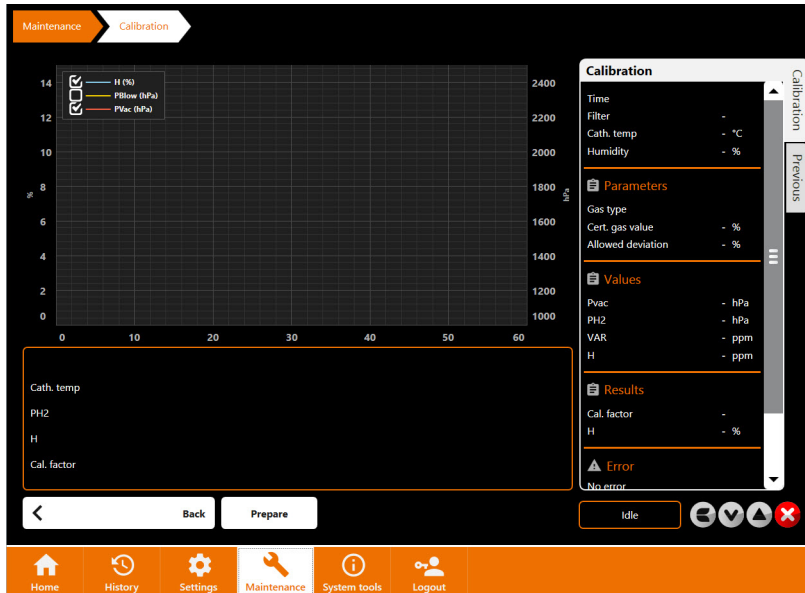
The system automatically runs the following procedure:

- At the start of the calibration program, the pneumatic unit sets the system to zero. The nitrogen gas is blown into the TCD.
- After the zerosetting, you are prompted to inject the calibration gas into the pneumatic unit using the calibration tool (available in the maintenance kit). Once a stable output is obtained, the new calibration factor is calculated.
- Repeat the calibration to confirm that the first calibration was correct. The calibration result is good when the calibration factor fits the requirement. This never happens on the first cycle. Perform a second cycle. Normally, after the third cycle, the result is good and the system enables the **Store** button.

## 11.7.1 Run a calibration

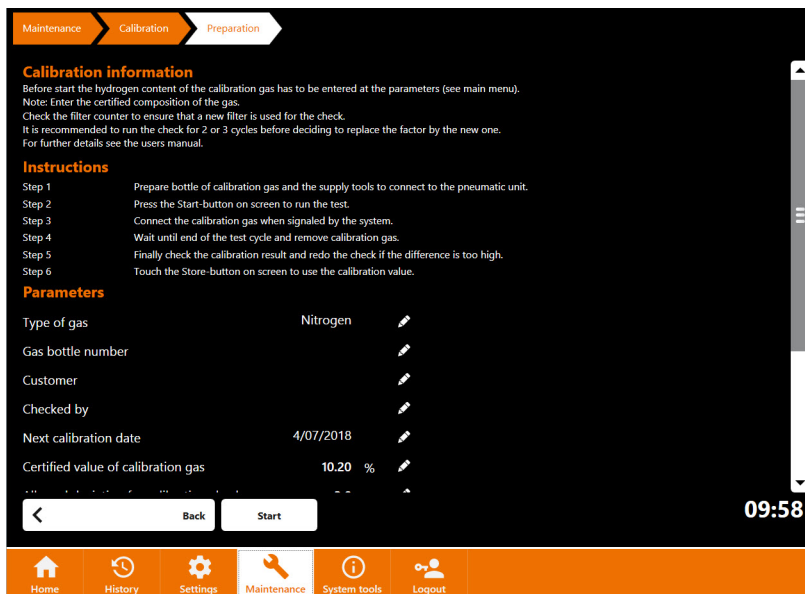
- 1 Prepare a bottle of calibration gas and the calibration tool to connect to the pneumatic unit.
- 2 Log in with the engineer password.
- 3 On the maintenance screen, click **Calibration**.

The calibration screen is shown.

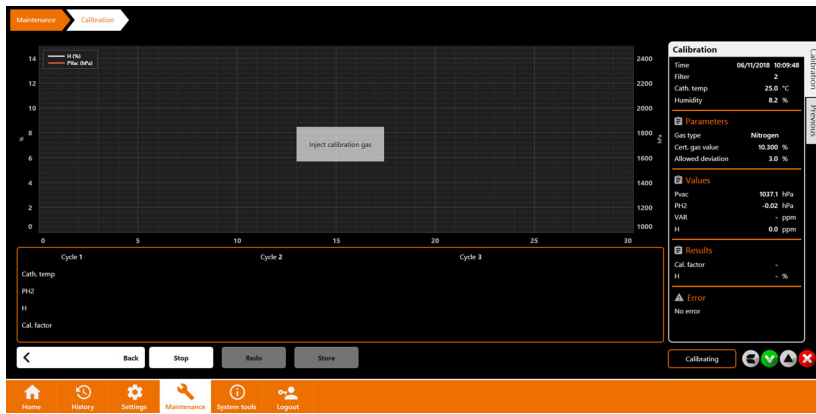


- 4 Click **Prepare** to initiate a new calibration.

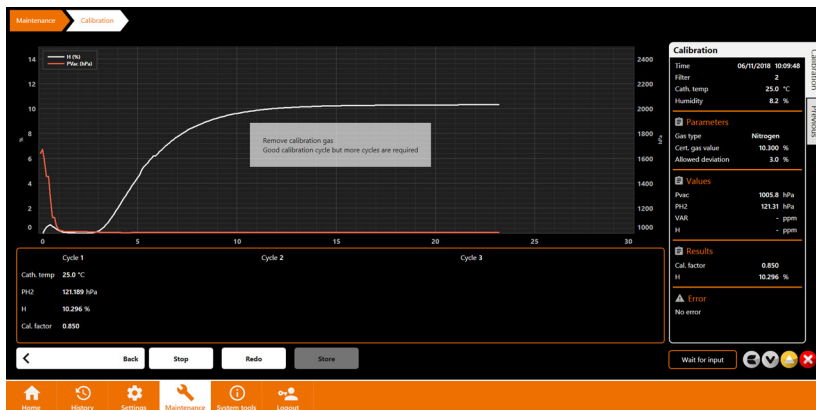
The preparation screen opens.



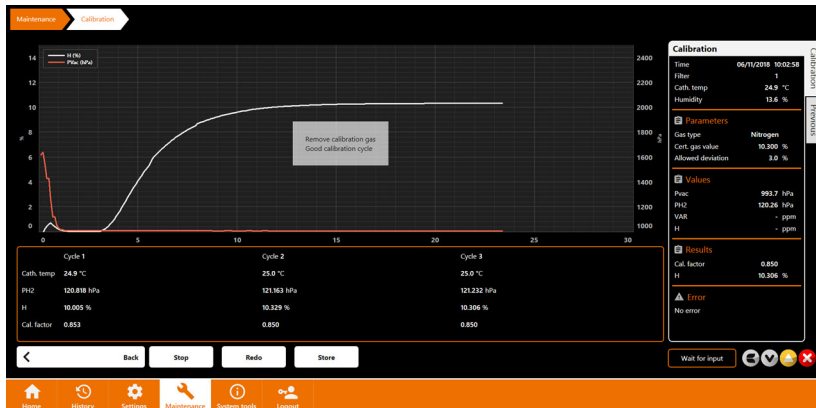
- 5 Check the composition of the calibration gas. Configure the parameters for the calibration.
- 6 Check the filter counter to ensure that a new filter is used for the calibration.
- 7 Click **Start** on the preparation screen to run the calibration test.
- 8 When the pop-up screen appears 'inject calibration gas', connect the calibration gas.



9 The calibration starts and shows the result when finished.



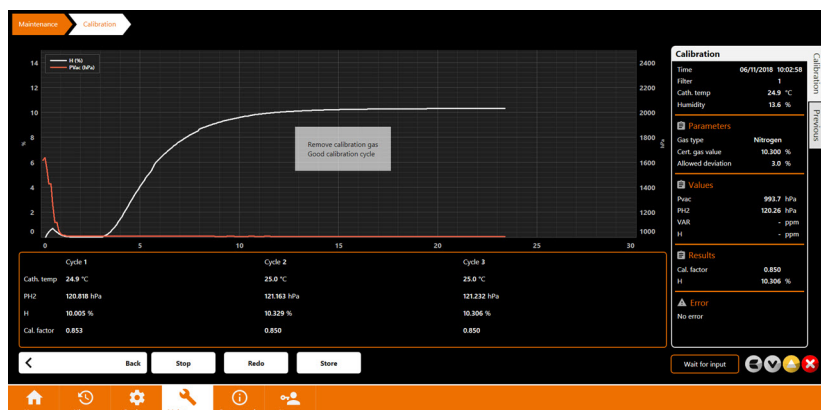
- 10 Disconnect the calibration gas as soon as the test cycle is finished.
- 11 Start a second test cycle, click **Redo**.
- 12 Repeat step 8 till 11 a least 2 times.



13 Click **Store** to save the result of the calibration, otherwise the system uses the old value. You can also force it to use the old value by clicking **Stop**.

## 11.7.2 Calibration result

The following shows a typical calibration result:



**Table 58: Calibration result fields explained**

Field	Description
Date	The date when the calibration was performed.
Time	The time when the calibration was performed.
Filter	The filter used for the calibration.
Cath. temp.	The temperature of the catharometer (thermal conductivity detector) when the calibration was performed.
Humidity	The relative humidity when the calibration was performed.
<b>Parameters</b>	
Gas type	The type of gas used for the calibration.
Cert. gas value	The certified value of the calibration gas.
Allowed deviation	The value by which the gas can deviate from its nominal value.
<b>Values</b>	
Pvac	The pressure in the vacuum circuit.
PH2	The partial pressure of hydrogen as measured by the Hydris® system.
VAR	The variation of the hydrogen in ppm during the period set in the standard window length parameter, for example, 10 seconds.
H	The amount of hydrogen as measured by the Hydris®
<b>Results</b>	
Cal. factor	The factor used to calculate the calibration results.
H	The amount of hydrogen as measured by the Hydris® system.
<b>Results Cycle x</b>	
Cath. temp (°C or °F)	The temperature of the catharometer on cycle x.
PH2 [hPa]	The amount of directly measured hydrogen on cycle x.
H [%]	The amount of hydrogen measured using the calibration factor on cycle x.
Cal. factor	The factor used to calculate the calibration results on cycle x.

The previous tab shows the results of the last calibration.

Previous	
Time	10/12/2018 14:05:57
Gas type	Nitrogen
Cert. gas value	10.200 %
Allowed deviation	3.0 %
<b>Cycles</b>	
Cath. temp	24.3 °C
PH2	127.52 hPa
H	10.238 %
Cal. factor	0.800
Cath. temp	24.3 °C
PH2	126.88 hPa
H	10.149 %
Cal. factor	0.804
Cath. temp	24.3 °C
PH2	127.09 hPa
H	10.217 %
Cal. factor	0.803

### 11.7.2.1 Calibration reference points

A calibration curve is selected on two reference points.

- Reference point 1: the system first sets the system to zero with clean nitrogen. The TCD signal during the purge with pure nitrogen is equalised to 0% hydrogen.
- Reference point 2: By introducing a well known mixture of hydrogen and nitrogen, the corresponding TCD signal is correlated to this particular mixture.

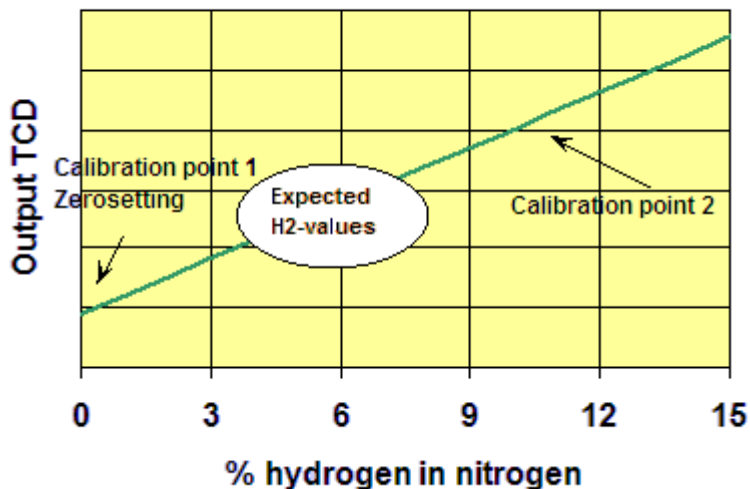
As the thermal conductivity of the hydrogen/nitrogen mixture has a linear correlation, it is sufficient to use two calibration reference points.

### 11.7.2.2 Measuring the Hydrogen content

Once calibrated, the system is ready to measure the hydrogen content in steel. To do this:

- 1 The pneumatic unit sets the system to zero (identical to the zero setting during calibration), so that reference point A is found.
- 2 The measurement is made. The output of the TCD is correlated to its specific hydrogen/nitrogen mixture on the calibration line.
- 3 This hydrogen content is converted to partial pressure according to the selected immersion depth.
- 4 This partial pressure is converted to ppm H<sub>2</sub> by applying Sievert's law.

### Calibration curve of Hydris



### 11.7.2.3 Influences on the calibration result

The environmental temperature influences the calibration. The system uses a formula to compensate for the influence of temperature on the calibration factor (TIC factors). To minimise the compensation required, the system should be recalibrated at least once every three months.

If very high inblow pressures are applied on the calibration gas during calibration, the calibration precision is affected. The pressure applied during calibration should only slightly exceed the atmospheric pressure to obtain optimal calibration characteristics.

## 11.7.3 Troubleshooting during calibration

### 11.7.3.1 The calibration does not start

#### Condition

The calibration does not start.

#### Cause

The calibration gas has not enough pressure. This pressure is needed to switch the vacuum valve.

#### Remedy

- 1 Check the pressure of the calibration gas bottle. This must be > 1600 hPa.
- 2 If the problem remains, check the connections for leaks between the pressure reducer and the calibration tool.

### 11.7.3.2 Different results

#### Condition

Different results are obtained by consecutive calibrations. The calibration factor of the consecutive calibration cycles differs more than 1%.

#### Cause

- leakage
- calibration bottle is empty
- The pressure in the vacuum circuit is too high.

#### Remedy

- 1 Check the calibration bottle. Is it almost empty, replace by a new one.
- 2 Check the pressure in the system.  $P_{vac} < 1500$  hPa.
- 3 If the problem remains, check the connections for leaks between the calibration gas and the calibration tool.

## 11.7.4 Using Argon as a carrier gas

In some circumstances, argon should be used as a carrier gas. However, when dissolved in steel, nitrogen is absorbed by the argon carrier gas, as well as the hydrogen, which is a drawback because the system calibration and measurement principal only considers a two-component gas.

The thermal conductivity of nitrogen is higher than argon. Hence, for low hydrogen values (3ppm) and high nitrogen values (50ppm), the hydrogen analysis is too high.

You need argon as the carrier gas in melts in which nitrogen either 'contaminates' the melt or is absorbed by the melt. These are mostly high-alloyed stainless steel grades. You also use argon if the porous stone of the Hydris® probe is clogged and the vacuum pressure drops too much during the measurement. However, you must not work with argon in stainless steel in general.

When switching from nitrogen carrier gas to argon, the system must be recalibrated. You should work with just one carrier gas at a time – either nitrogen or argon. If you are using argon as the carrier gas, the system must be recalibrated with argon. Use a calibration gas with 10% hydrogen and 90% argon. With an air measurement using argon ( $K/f = 0.75$ ) you'll get a value between 7.5 and 8ppm.

**Table 59:**

K/f	Air Test Measurement ( $\pm 5\%$ )	Test Gas Measurement 9.63%
0.50	4.8 (4.6 – 5.0)	4.9
0.60	5.8 (5.5 – 6.1)	5.9
0.65	6.2 (5.9 – 6.5)	6.4
0.70	6.7 (6.4 – 7.0)	6.9
0.75	7.2 (6.8 – 7.6)	7.4
0.80	7.7 (7.3 – 8.1)	7.9
1.00	9.6 (9.1 – 10.1)	9.8

## 11.8 Test gas measurement

### Before you begin:

#### Personnel:

**Number of workers:** 1

**Category:** Heraeus Electro-Nite engineer

#### Equipment:

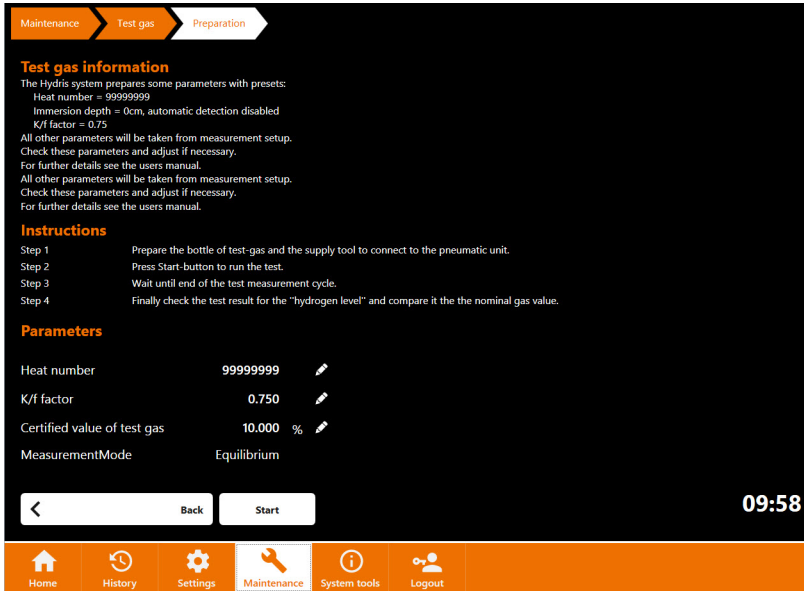
- Test gas with a known Hydrogen content (see calibration gas paragraph 11.7).

The test gas measurement checks the accuracy of the system. It should be performed regularly.

Further investigation of the system is required if there is an unacceptable difference between the actual and target value, taking the  $K/f$  factor into account.

- 1 Click [Maintenance](#) > [Test gas](#)  
The last test gas measurement result will be shown.
- 2 Click [Prepare](#).

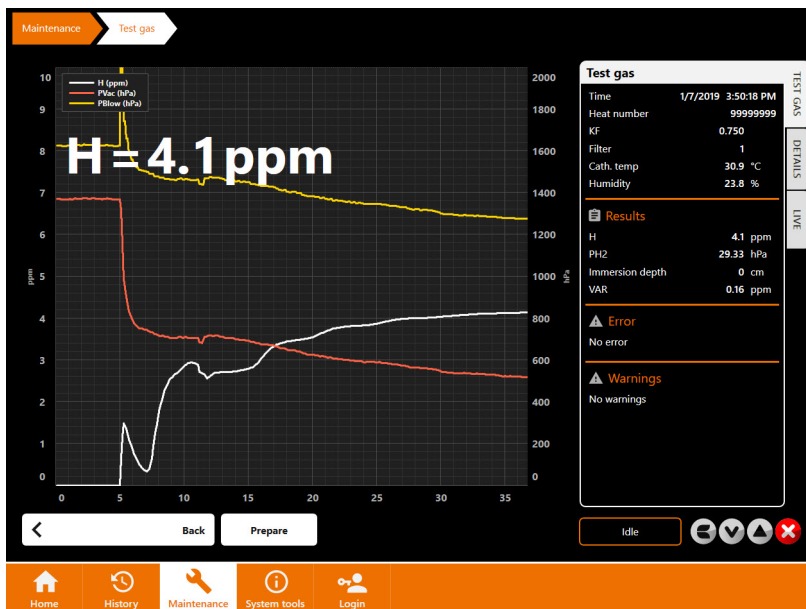
3 Configure the test gas parameters.



4 Prepare the bottle of test gas and the supply tool to connect to the pneumatic unit.

5 Click **Start**.

Example: Result test gas measurement



Field	Description
Date	The date when the test gas measurement was performed.
Time	The time when the test gas measurement was performed.
Heat number	The number of the heat used for the test gas measurement.
KF	The k/f factor for the test gas measurement.
Filter	The filter used for the test gas measurement.

Field	Description
Cath. temp	The temperature of the catharometer (thermal conductivity detector) when the test gas measurement was performed.
Humidity	The relative humidity when the test gas measurement was performed.
<b>Results</b>	
H	The amount of hydrogen .
PH2	The partial pressure of hydrogen as measured by the system
Immersion depth	
VAR	The variation of the hydrogen in ppm during the period set in the standard window length parameter, for example, 10 seconds.

## 11.9 Manual Access

- 1 Log in with the engineer password.
- 2 Click **Maintenance** > **Manual Access**  
The overview of the system is shown.

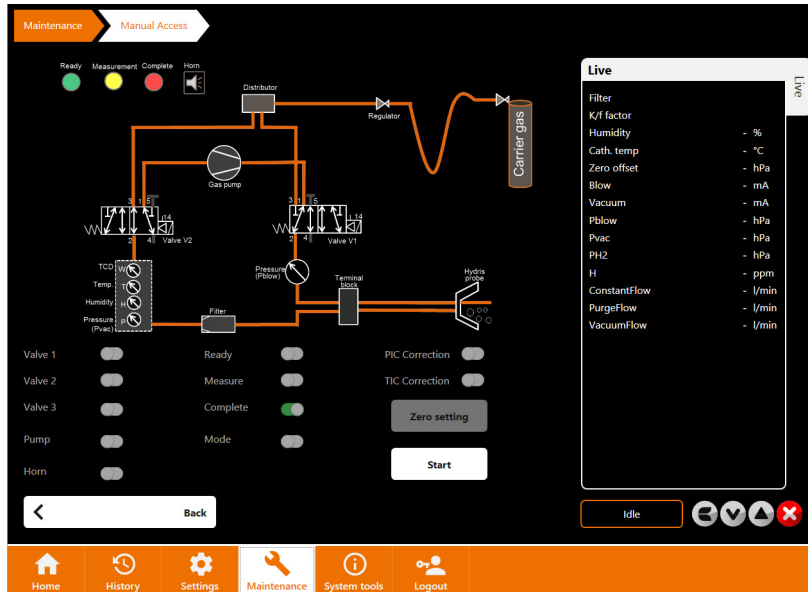


Figure 29: Manual Access screen

- 3 Click **Start** to begin using manual access.
- 4 Click **Stop** to stop using manual access.

## 11.10 Diagnostics overview

- 1 Log in with the engineer password.
- 2 Click **Maintenance** > **Diagnostics overview**

The screenshot displays the 'Diagnostics overview' screen with a dark background and orange accents. At the top, there are two tabs: 'Maintenance' (selected) and 'Diagnostics overview'. Below the tabs, the screen is divided into four panels, each showing test results for a specific date and time.

Test Type	Date/Time	Parameter	Value	Unit
Calibration	14/07/2008 0:00:00	Cath. temp	44.2	°C
		Cycle	1	
		Cal. factor	0.931	
		H	107.79	hPa
		H	10.022	%
		Gas type	Nitrogen	
		Cert. gas value	10.030	%
		Allowed deviation	3.0	%
Filter	2			
Test gas	3/04/2018 8:30:08	Cath. temp	25.9	°C
		Pblow	1274.25	hPa
		Pvac	517.60	hPa
		PH2	31.83	hPa
		H	4.23	ppm
		VAR	0.17	ppm
		Gas type	Nitrogen	
		Cert. gas value	10.000	%
Air test	3/04/2018 8:23:54	Cath. temp	24.2	°C
		Pblow	1274.25	hPa
		Pvac	517.60	hPa
		PH2	31.62	hPa
		H	4.22	ppm
		VAR	0.17	ppm
		K/f factor	0.750	
		Filter	27	
Leakage test	9/11/2017 15:53:43	Cath. temp	25.0	°C
		Start Pvac	2000.0	hPa
		Pressure loss	1.0	hPa
		Start Pblow	2000.0	hPa
		Pressure loss	1.0	hPa
		Max allowed P-loss	20.0	hPa
		Leakage check time	30	s
		Result	Passed	

At the bottom of the screen, there is a navigation bar with icons for Home, History, Settings, Maintenance (selected), System tools, and Logout. A 'Back' button is also visible above the navigation bar.

Diagnostics overview screen

## 11.11 Replace the tar filter

You are advised to use a tar filter. This filter prevents dust particles and tar clogging either the pneumatic hose or pneumatic system.

The filter keeps maintenance down and avoids potential repairs. The filter can be installed either between the pneumatic hose/pneumatic unit or the pneumatic hose/ lance.

The tar filter block includes a small filter. Replace this small filter every 100 to 200 measurements. Ask your local Heraeus Electro-Nite representative for the order numbers.



Tar filter block with disposable filter

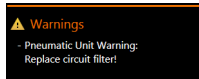


**Figure 30:** Pneumatic unit with tar filter block mounted next to the moisture filter

## 11.12 Replace the moisture filter

The moisture filter is used to absorb all moisture in the pneumatic circuit. To prevent residual moisture affecting the measurement, you must regularly replace the filter. When:

- the moisture filter colour changes from orange (good) to white (must be changed).
- the filter counter exceeds its limit (can be modified in the parameter list, standard value: 35, maximum 70), the system gives a warning at the start of each measurement. The filter counter is visible on the display.



- a lance gets burned. Dirt could clog up in the filter, indicated by the black colour in the bottom (unless a tar filter is used).
- a leak is detected in the filter.
- the system is calibrated.

The user will not be prevented from measuring, but as a consequence, the result of the hydrogen measurement can be inaccurate.

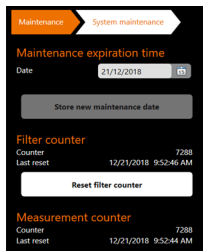
The moisture filter contains silica gel, which is a non-hazardous product as specified in directive 67/548/ECC. Ask your local Heraeus Electro-Nite representative for the order number.



**Note:** The filters can be bought in sets of 10. Due to atmospheric moisture, its life can be limited. You are therefore advised to limit the quantity of filters in stock. You must not reheat the filters to remove moisture. This could result in clogging, a bad gas circulation, and leaks.

When the filter has been replaced the filter counter has to be reset:

- 1 Click **Maintenance > System maintenance**



- 2 Click **Reset filter counter.**

## 12. Troubleshooting

### 12.1 Leakage

#### 12.1.1 Condition

A leak is detected

#### 12.1.2 Cause

- 1 filter needs to be replaced
- 2 pump is defective
- 3 leaking valve(s)

#### 12.1.3 Check the filter

The filter is often responsible for a leak in the system. Change the filter once there is a leak.

#### 12.1.4 Check the pump

If the filter turns out to be alright, the pump should be checked. Since the pump is not used during the leak detection test, it can easily be omitted. Short-circuit tubes 7 and 8 and run the normal leak detection procedure. If no leak is found, the pump is defective and must be repaired or replaced.

#### 12.1.5 Check the valves

Detecting a leaking valve is not as easy as detecting a leaking pump, since the valves do function during the leak detection test. An additional leak detection test can help you locate the origin of the leak. Before doing so, first check the filter and pump and tighten the screw at the different connections. A pump that isn't sealed properly inside can cause a small leak between the blow and vacuum sides. Therefore, seal off tube 7, so that there is no short circuit between the blow and vacuum sides. If a leak is found, replace valve 1. If not, replace valve 2.

The pump and both valves are the only components with moving parts, so check these first if a leak is detected. Leaks in the TCD and pressure sensors are very unlikely.

### 12.2 Error messages

#### 12.2.1 Put probe on probeholder

##### 12.2.1.1 Error message

Put probe on probeholder.

### 12.2.1.2 Cause

Check first that the probe is on the probeholder. If the error remains, possibly the pump is not functioning.

### 12.2.1.3 Procedure

- 1 Open the pneumatic unit.
- 2 Start a measurement.  
The system activates the pump as one of the first steps in the measurement process.
- 3 If the pump does not start, it must be checked or replaced.
- 4 Open the **Manual Access** window to check that the electronic output for the pump is functioning.
- 5 Click **Start**.
- 6 If that reveals no problems, contact Heraeus Electro-Nite for replacement or service.

## 12.2.2 Valve

### 12.2.2.1 Error messages

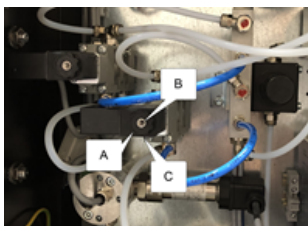
- Valve 1, blow valve.
- Valve 2, vacuum valve.

### 12.2.2.2 Cause

Check first the nitrogen supply. If nitrogen is connected, the valve could be defective.

### 12.2.2.3 Procedure

- 1 Open the pneumatic unit.
- 2 Start a measurement.  
The system activates valve 2 as one of the first steps in the measurement process. Valve 1 is activated as soon as the message 'gas pressure too low' is displayed.
- 3 If one of the valves does not work, it must be checked or replaced.
- 4 Open the **Manual Access** window to check if the electronic output for the valves is functioning.
- 5 Click **Start**.  
If one of the valves is not working, use the solenoid from the other valve to see if that works with the defective valve.
- 6 Remove the solenoids (A) by unlocking the screw (B).



By exchanging the solenoids from vacuum valve to blow valve (or the other way round), you can check whether the coils are defective.

- 7 Alternatively, you can quickly check whether the valve functions by turning the black screw (C - not visible in the figure) and listening to the valve switch.
- 8 If the problem still exists, contact Heraeus Electro-Nite for replacement or service.

## 12.3 No stable zero setting

### 12.3.1 Condition

The system

- continues to search for a good zero setting during initialisation without finding a stable value.
- does not find a zero setting when starting up a measurement.

### 12.3.2 Cause

The thermal conductivity detector is not functioning.

### 12.3.3 Procedure

Check the voltage change of the TCD on the electronics board, without mains power. The following values need to be found (at room temperature):

- Pin connectors 9 and 10 (X5): 1500 to 2500 Ohm.
- Pin connectors 11 and 12 (X5): 1500 to 2500 Ohm.

## 12.4 Repairing a lance

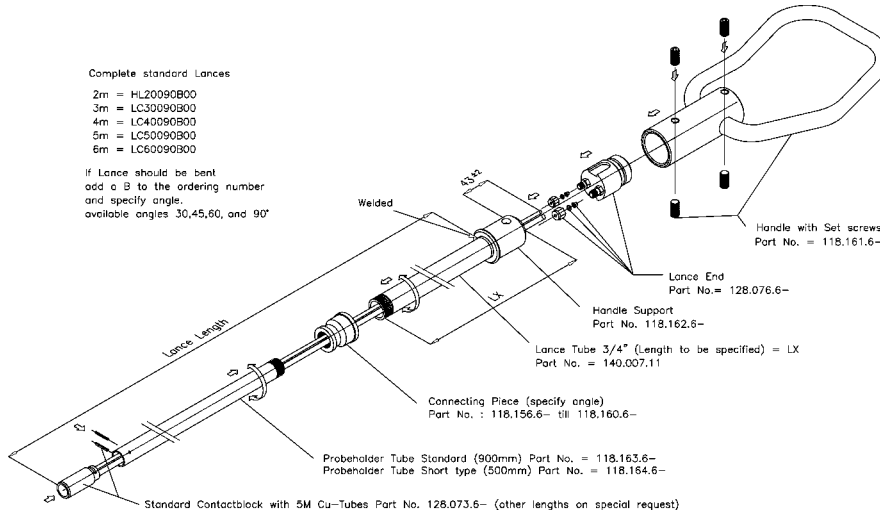
Follow this process to repair a lance:

- 1 Remove the handle and lance end (Remove the handle and lance end).
- 2 Remove the probe holder tube and contact block assembly 12.4.2 .
- 3 Remove the contact block assembly 12.4.3
- 4 Replace probe holder tube (if necessary) 12.4.4 .
- 5 Replace contact block assembly 12.4.5 .
- 6 Connect copper tubes and lance end 12.4.6 .
- 7 Fix Hydris<sup>®</sup>/Nitris handle 12.4.7 .
- 8 Fix the contact block. 12.4.8
- 9 Carry out a leak test.

### 12.4.1 Remove the handle and lance end

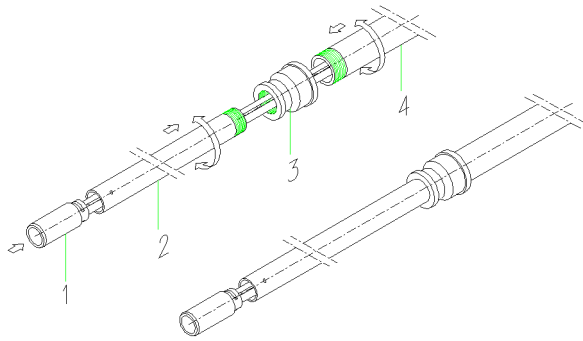
- 1 Loosen screws 11.

- Disconnect the copper tubes (1) by loosening couplings (6-7-8).



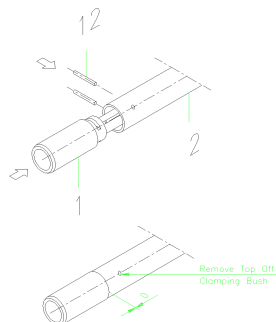
### 12.4.2 Remove the probe holder tube and contact block assembly

- Unscrew the probe holder tube (2).
- Pull out the copper tubes (1).
- Cut the probe holder tube if necessary.



### 12.4.3 Remove the contact block assembly

- Remove clamping bushes (12).
- Disconnect lance tube (4).
- Probe holder tube (2) from connecting piece 3.
- Pull out the copper tubes (1).



## 12.4.4 Replace probe holder tube

- 1 Screw the probe holder tube (2) in the connecting piece (3).

## 12.4.5 Replace contact block assembly

- 1 Push the assembly (1) on to the probe holder tube (2), connecting piece (3), and lance tube (4).

## 12.4.6 Connect copper tubes and lance end

**Before you begin:** Ensure that the contact block assembly is completely pushed against the probe holder tube.

- 1 Cut the copper tubes to the correct length (43mm).

 **Tip:** Use the tube cutter.

- 2 Push the copper tubes in the couplings (6-7-8) of the lance end.
- 3 Lock them carefully.

## 12.4.7 Fix the handle

- 1 Slip the handle over the lance end.
- 2 Tighten first handle (10) and lance end (9) using two screws (11).
- 3 Lock handle on the handle support (5) using two remaining screws (11).
- 4 Check if the handle is positioned correctly towards the bend.

## 12.4.8 Fix the contact block

- 1 Use new clamping bushes (12).
- 2 File off the top of the contact block so it is smooth.

## 13. Spare parts

If repairs are necessary, contact your local Heraeus Electro-Nite sales representative.



**Note:** Always replace the detachable mains supply cord with a cord with adequate rating (type: H05VV-F 3G1 mm<sup>2</sup>, UCS number 33980077) .

When ordering spare parts, always provide the instrument type and instrument serial number.

# 14. Appendix

## 14.1 ASCII Table

ascii	hex	char	ascii	hex	char	ascii	hex	char	ascii	hex	char
0	0	NULL	32	20	SPACE	64	40	@	96	60	`
1	1	SOH (Start of Header)	33	21	!	65	41	A	97	61	a
2	2	STX (Start of Text)	34	22	"	66	42	B	98	62	b
3	3	ETX (End of Text)	35	23	#	67	43	C	99	63	c
4	4	EOT (End of Transmission)	36	24	\$	68	44	D	100	64	d
5	5	ENQ (Enquiry)	37	25	%	69	45	E	101	65	e
6	6	ACK (Acknowledgement)	38	26	&	70	46	F	102	66	f
7	7	BEL (Bell)	39	27	'	71	47	G	103	67	g
8	8	BS (Backspace)	40	28	(	72	48	H	104	68	h
9	9	HT (Horizontal Tab)	41	29	)	73	49	I	105	69	i
10	0a	LF (Line Feed)	42	2a	*	74	4a	J	106	6a	j
11	0b	VT (Vertical Tab)	43	2b	+	75	4b	K	107	6b	k
12	0c	FF (Form Feed)	44	2c	,	76	4c	L	108	6c	l
13	0d	CR (Carriage Return)	45	2d	-	77	4d	M	109	6d	m
14	0e	SO (Shift Out)	46	2e	.	78	4e	N	110	6e	n
15	0f	SI (Shift In)	47	2f	/	79	4f	O	111	6f	o
16	10	DLE (Data Link Escape)	48	30	0	80	50	P	112	70	p
17	11	DC1 (Device Control 1)	49	31	1	81	51	Q	113	71	q
18	12	DC2 (Device Control 2)	50	32	2	82	52	R	114	72	r
19	13	DC3 (Device Control 3)	51	33	3	83	53	S	115	73	s
20	14	DC4 (Device Control 4)	52	34	4	84	54	T	116	74	t
21	15	NAK (Negative Acknowledgement)	53	35	5	85	55	U	117	75	u
22	16	SYN (Synchronous Idle)	54	36	6	86	56	V	118	76	v
23	17	ETB (End of Transmission Block)	55	37	7	87	57	W	119	77	w
24	18	CAN (Cancel)	56	38	8	88	58	X	120	78	x
25	19	EM (End of Medium)	57	39	9	89	59	Y	121	79	y
26	1a	SUB (Substitute)	58	3a	:	90	5a	Z	122	7a	z
27	1b	ESC (Escape)	59	3b	;	91	5b	[	123	7b	{
28	1c	FS (File Separator)	60	3c	<	92	5c	\	124	7c	
29	1d	GS (Group Separator)	61	3d	=	93	5d	]	125	7d	}
30	1e	RS (Record Separator)	62	3e	>	94	5e	^	126	7e	~
31	1f	US (Unit Separator)	63	3f	?	95	5f	_	127	7f	



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