



HPR30 Process Gas Analysis System, with QIC Inlet, User Manual

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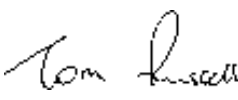
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HPR30 Process Gas Analysis System, with QIC Inlet, User Manual

Manual Number: HA-085-575 Issue: B

Written by:  Date: 20 June 2001

Checked by:  Date: 20 June 2001

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A copy of the Hiden Analytical Limited Website is also included on the Hiden Analytical Software Suite Compact Disk (CD); this can be accessed by double-clicking on the index.htm file in the html directory in the Windows Explorer.



Certificate Number 6738

Contents

HPR30 Process Gas Analysis System, with QIC Inlet, User Manual ····· i

Copyright notice ····· i

Acknowledgements ····· i

Instructions ····· i

Importance of this Manual ····· i

Technical assistance ····· i

Amendments ····· ii

Amendment history ····· ii

FCC Notices ····· ii

1 About this manual ····· 1

2 System description ····· 1

 2.1 General ····· 1

 2.2 Documentation ····· 1

 2.3 System description ····· 2

3 The Mass Spectrometer ····· 5

4 Technical data ····· 7

 4.1 Electrical specification ····· 7

 4.2 Pneumatic supply ····· 7

 4.3 Environmental data ····· 7

5 Symbols ····· 7

6 System use ····· 8

 6.1 Removing the Sub-Frame ····· 8

 6.2 Removing the Inlet Manifold Assembly ····· 8

 6.3 Leak Checking ····· 9

 6.4 Baking ····· 9

7 System operation Low Pressure mode ····· 9

 7.1 Introduction ····· 9

 7.2 Initial System set-up Low Pressure Operation ····· 10

 7.3 System start-up procedure ····· 11

 7.4 Process Mode (1 Torr maximum) ····· 11

7.5 RGA Mode 1×10^{-5} Torr max. 12

7.6 System shut-down procedure 13

8 System operation High Pressure mode (2 atm. max.) 14

8.1 Introduction 14

8.2 Initial system set up High Pressure mode 14

8.3 System operation High Pressure mode (100 Torr to 2 atm.) 15

8.4 System shut down High Pressure mode 16

9 Changing the orifice cap 17

Illustrations

Figure 1 HPR30 Process Gas Analysis System 4

Figure 2 HPR30 Process Gas Analysis System schematic diagram 5

Figure 3 HPR30 Inlet Manifold Assembly 6

Tables

Table 1 Orifice sizes 17

HPR30 Process Gas Analysis System, with QIC Inlet, User Manual

The purpose of this Manual is to describe the HPR30 Process Gas Analysis System, with QIC Inlet, and its operation. This Manual should be read in conjunction with the supplied Operator's Manuals for the mass spectrometer and other relevant equipment.

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Instructions

For clarity, the instructions given in this Manual are presented in two columns. The left-hand column provides imperative instructions that are numbered sequentially to provide a step-by-step guide through the functions. The right-hand column describes the system's response (where appropriate) and gives any additional information that may be of relevance.

Importance of this Manual

This Manual should be regarded as part of the product described herein.

Technical assistance

Technical assistance can be obtained from the Hiden Analytical Limited Service Department which can be contacted on:

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In the U.S.A. and Canada, technical assistance can be obtained from Hiden Analytical Inc.:

Email: HidenAL@AOL.com

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Toll-free phone: 1-888-96 HIDEN

Ext. 2 U.S.A. and Canada Service Department

Ext. 3 U.K. Manufacturing Facility

Amendments

This Manual will be updated, as necessary, to cover modifications to the product. Amendments may take the form of Addenda, which will be located at the back of the Manual, on coloured paper.

Amendment history

Issue: A Date: 15 June 2001

Issue: B Date: 20 June 2001

Title changed to remove WR reference.

FCC Notices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note that FCC regulations provide that changes or modifications not expressly approved by Hiden Analytical Limited could void the user's authority to operate this equipment.

Shielded Cables: Use only shielded cables for connecting peripheral equipment to any Hiden Analytical Limited equipment; this reduces the possibility of interference with radio and television reception. Using shielded cable ensures that the appropriate FCC radio frequency emissions compliance of the equipment is maintained.

1 About this manual

This manual is the first in a series of documents that are supplied as part of the HPR30 Process Gas Analysis System.

The purpose of this manual is:

- To provide an overview of the complete system
- To give operational details of the system
- To list the other documents supplied as part of the equipment
- To describe any amendments to the documentation or areas where there are differences between the equipment supplied and that described in the documentation.

2 System description

2.1 General

The Hiden Analytical Limited HPR30 Process Gas Analysis System with QIC Inlet, and the associated Mass Spectrometer and control equipment is mounted on a mobile trolley, see Figure 1. This System allows sampling from pressures between Ultra-High Vacuum (UHV) and 1 Torr via the HPR30 manifold or sampling in the pressure range 100 Torr to 2 atm. (1 bar.g) via the QIC inlet. This system combines the features of the standard HPR30 process gas analysis system with those of the HPR20 benchtop gas analysis system.

2.2 Documentation

This manual (reference HA-085-575) gives details of the complete HPR30 Process Gas Analysis system. Details of specific parts of the system can be found in the other manuals.

The HPR30 system is based on the Hiden Analytical RC PIC quadrupole mass spectrometer which is described in the manual HA-085-014.

The HPR30 inlet with dual electro-pneumatic valves is described in the manual HAV-001-015. This inlet is controlled by the Automatic Valve Controller (AVC1) described in the manual HA-085-012. The additional QIC (Quartz Inert Capillary) Fast Sampling Capillary Inlet is described in HA-085-027. The QIC Inlet can be heated and the Capillary Temperature Controller is detailed in the manual HA-085-026. The Turbo Interface unit is described in HA-085-044.

The HPR20 Gas Analysis System is described in the manual reference HAV-001-017.

Two software packages are supplied as part of the complete system;

MASsoft (see manual reference HA-085-004) and the Statistical Process Control software SPCsoft (see manual reference HA-085-020).

The manuals are supplied in a ring binders. Usually, due to its size, the MASsoft manual will be in one binder and the other manuals in a second binder.

2.3 System description

Figure 1 shows the main system components and layout. Figure 2 is the schematic diagram of the sampling and vacuum components. Figure 3 shows the HPR30 manifold.

The mass spectrometer vacuum chamber is pumped by the turbo pump, backed by the membrane pump.

The QIC Inlet Isolation, Bypass Isolation and Sample Bypass Control valves are manually operated. The RGA and Process valves are electro-pneumatically operated under the control of the AVC1 Automated Valve Controller (for details see Hiden Analytical Limited Manual number HA-085-012, “AVC1 Automated Valve Controller User Manual”).

The Penning gauge indicates the pressure in the mass spectrometer vacuum chamber. The Penning gauge also provides a trip function to the AVC1 Automated Valve Controller to close the Process and RGA valves and switch off the Mass Spectrometer ionisation source filaments (via the Mass Spectrometer Interface Unit) if pressure exceeds 5×10^{-5} Torr (or the user-configured value). The Penning gauge has a single controller with dedicated display.

The HPR30 with QIC inlet has two operating modes defined by the inlet system being used:

High Pressure mode 100 Torr to 2 atm. using the QIC capillary inlet

Low Pressure mode UHV to 1 Torr using the HPR20 inlet manifold.

In the low pressure mode of operation the HPR20 will sample the process chamber using either the process valve (pressure between 1 Torr and 5×10^{-5} Torr) or the RGA valve (pressure below 5×10^{-5} Torr).

When operating with a high pressure in the process chamber (2 atm. maximum), the QIC inlet is used, with the QIC Inlet Isolation valve and Bypass Isolation valves open, and the Process and RGA valves closed. The Sample Bypass Control valve is opened to suit the sample pressure in the process chamber, see Section 8. Refer to Hiden Analytical Limited Manual number HA-085-027, “QIC Fast Sampling Capillary Inlet for Low Pressure Sampling User Manual” for further details of the QIC inlet.

When operating in the Process Mode, with a relatively high pressure in the process chamber (1 Torr maximum), the QIC Inlet Isolation valve and Bypass Isolation valves are closed, the RGA valve is closed and the Process valve is open, see Section 7.4.

When operating in the RGA Mode, with a low pressure in the process chamber, the QIC Inlet Isolation valve and Bypass Isolation valves are closed, and the Process and RGA valves are both open, see Section 7.5.

The complete HPR30 system is mounted on a mobile trolley for ease of transportation between process chambers. A detachable sub-frame houses the membrane backing pump, inlet manifold assembly and some of the control units. This sub-frame may be removed from the trolley and sited up to 6 metres away.

The inlet manifold assembly containing the mass spectrometer probe, turbo pump inlet assembly and QIC inlet is fitted directly onto the process chamber for operation in the low pressure mode. The manifold assembly is removed from the sub-frame and connected to the process chamber via the CF-35 inlet flange.

CAUTION

The HPR30 manifold assembly MUST be supported once it is connected to the process chamber. DO NOT rely on the CF35 Conflat flange connection

In the high pressure mode of operation the HPR30 manifold is left fitted to the sub-frame and the capillary inlet is connected to a separate port on the process chamber.

CAUTION

The High Pressure Mode and Low Pressure Mode are two separate modes of operation. The HPR30 with QIC inlet may not be used continuously from 2atm. to UHV without the risk of damage to the system. The HPR30 must be shut down before changing from the High Pressure to Low Pressure mode OR when changing from the Low Pressure mode to the High Pressure mode.

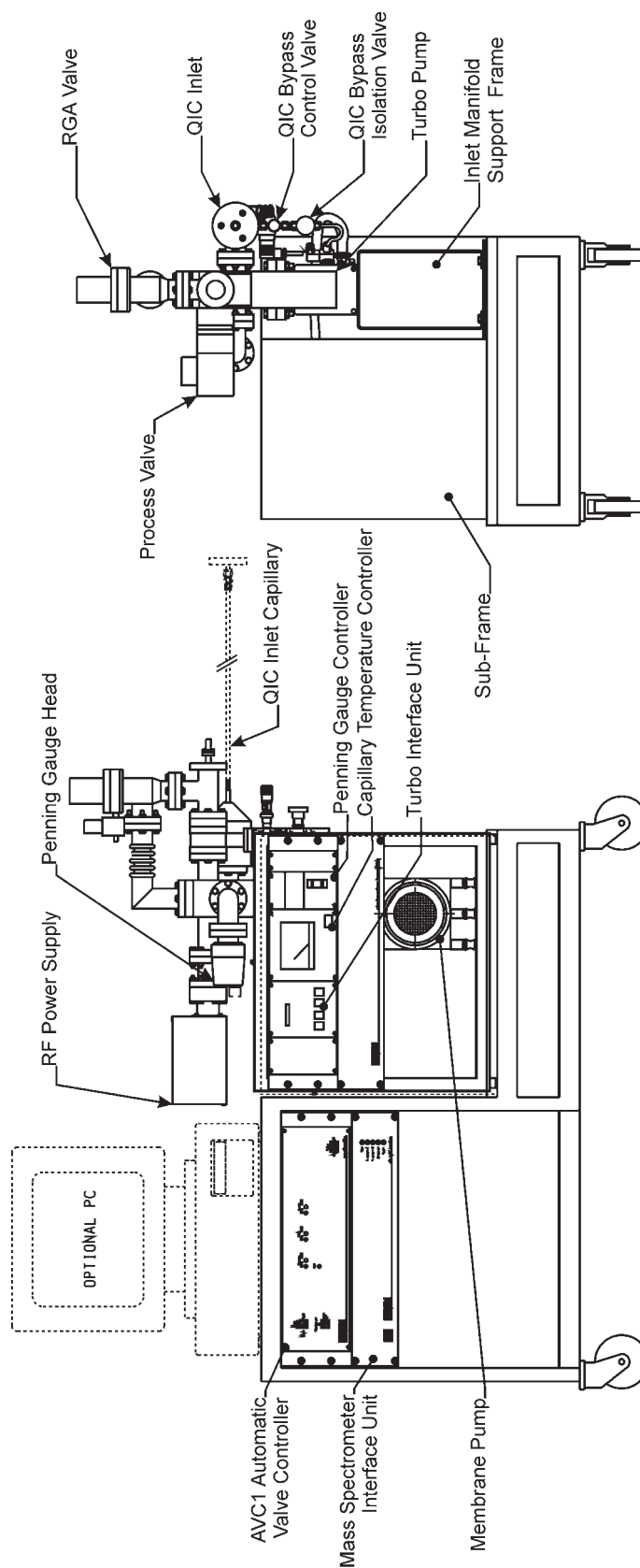


Figure 1 HPR30 Process Gas Analysis System

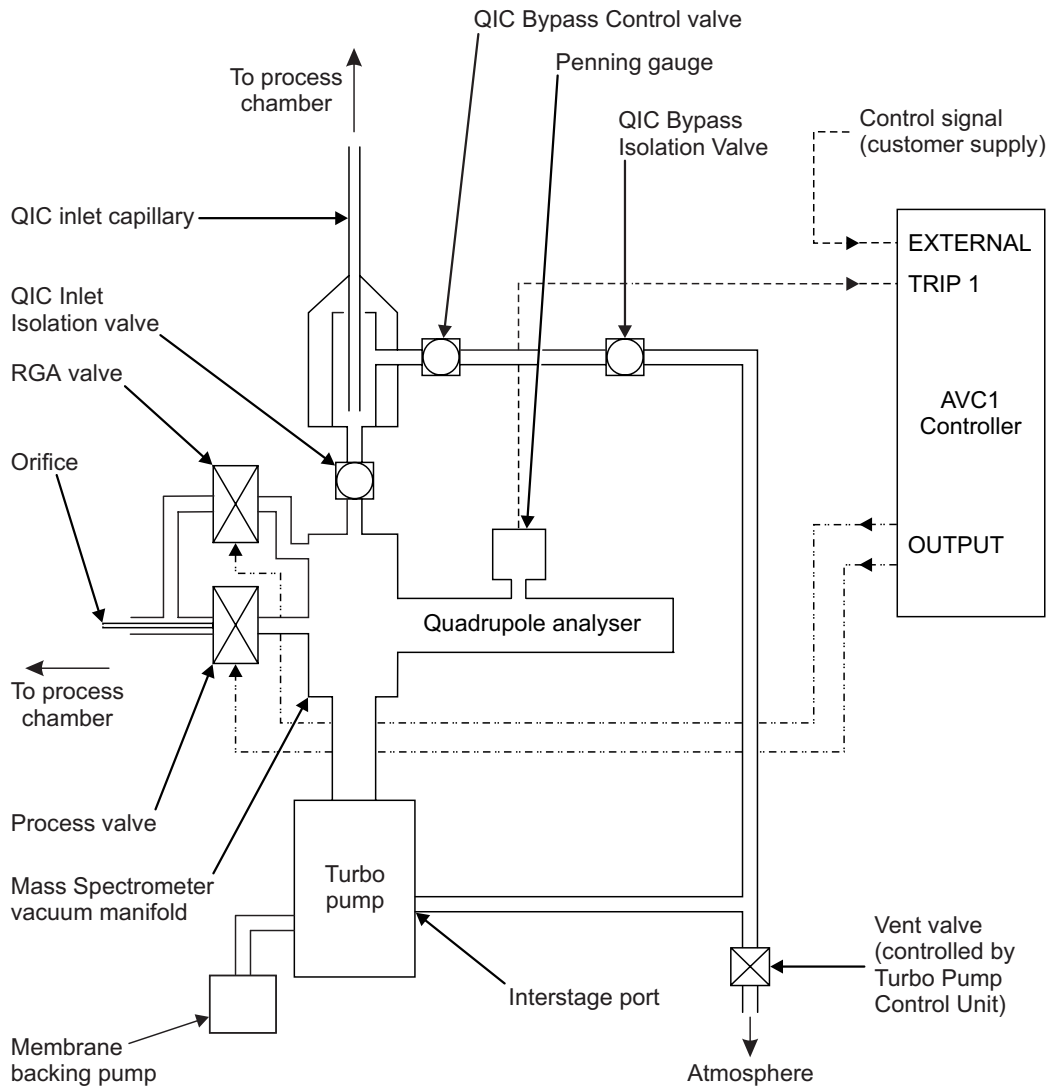


Figure 2 HPR30 Process Gas Analysis System schematic diagram

3 The Mass Spectrometer

CAUTION

Ensure that the pressure indicated by the Penning gauge, is less than 1×10^{-5} Torr before operating the Mass Spectrometer; failure to do this may damage the instrument.

Please refer to the appropriate Mass Spectrometer Operator's Manual; this is supplied with the System.

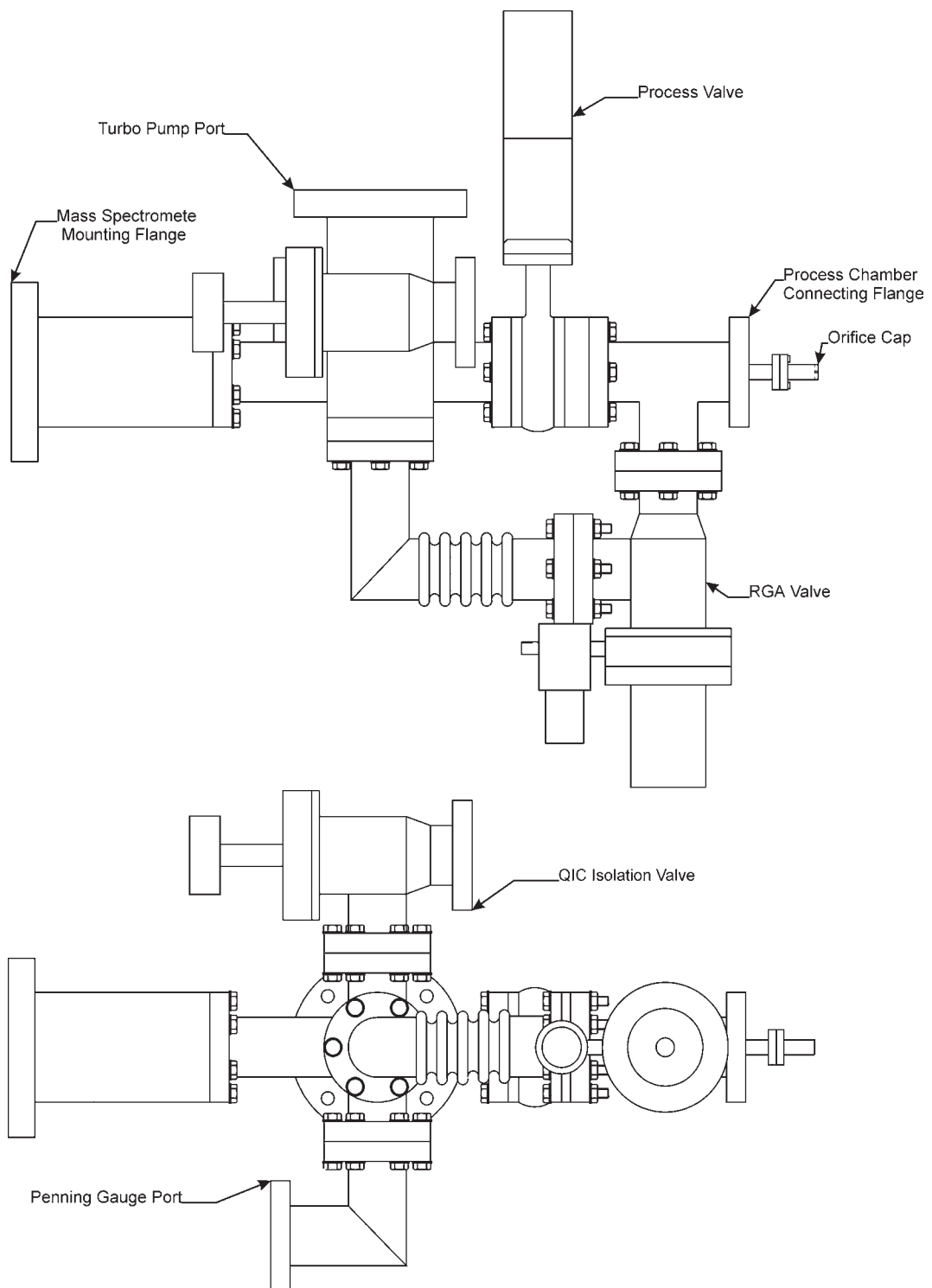


Figure 3 HPR30 Inlet Manifold Assembly

4 Technical data

4.1 Electrical specification

Voltage: 110 V

Frequency: 60 Hz.

Power: 3 kVA maximum.

4.2 Pneumatic supply

Compressed air or nitrogen, pressure: 70 to 80 psi.

4.3 Environmental data

Operating temperature range: 5 to 40 °C.

Storage temperature range: 0 to 50 °C.

Note:

The HPR30 Process Gas Analysis System may be stored temporarily at temperatures down to -10 °C.

Relative humidity range: 20 to 80 % non-condensing.

5 Symbols

The following symbols may be found on the equipment:



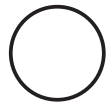
Alternating current.



Earth terminal.



On (supply).



Off (supply).



Caution, risk of electric shock.

Background colour: yellow.

Symbol and outline: black.

The above symbol is displayed adjacent to connectors carrying voltages ≥ 1000 V.



Caution, refer to associated documents.

Background colour: yellow.

Symbol and outline: black.



Hot surface.

Background colour: yellow. Symbol and outline: black.

The above symbol is displayed on surfaces that reach high temperatures, or on covers which, when removed, reveal hot surfaces.

6 System use

WARNING

When installed by Hiden Analytical Limited, the HPR30 Process Gas Analysis System is suitable for use as described in this Manual; any attempt to use it for any other purpose may cause injury, is liable to damage the System and will invalidate its Warranty.

If in doubt as to its suitability for an application, please contact Hiden Analytical Limited for advice.

6.1 Removing the Sub-Frame

The sub-frame is fitted onto the mobile trolley but may be remove and sited up to 6 metres from the trolley.

WARNING

The sub-frame is a heavy assembly. Lift it from the trolley in accordance with safe working practise. We recommend the sub-frame is lifted by two people.

CAUTION

Disconnect the HPR30 from the mains supply and make sure the turbo pump rotor is stationary before moving the manifold assembly.

The sub-frame rests on the lower surface of the trolley. It is not held in place by any fixing so, may be lifted using the handles at the front and back.

6.2 Removing the Inlet Manifold Assembly

WARNING

The inlet manifold is a heavy assembly. Lift it from the sub-frame in accordance with safe working practise.

CAUTION

Disconnect the HPR30 from the mains supply and make sure the turbo pump rotor is stationary before moving the manifold assembly.

The inlet manifold assembly is attached to the sub-frame by four M5 cap head screws securing the support frame to the bottom of the turbo pump.

Using a 4mm Allen key remove the four M5 cap head screws from the underside of the support frame.

Carefully, lift away the HPR30 inlet manifold.

6.3 Leak Checking

As part of the manufacturing process the HPR30 was helium leak checked. When you fit the HPR30 to the process chamber you will be making new vacuum seals and we recommend you leak check these before using the HPR30 system for process monitoring.

We also recommend that when the HPR30 is used for the first time the complete system is leak checked to guard against any leaks introduced by shipping damage.

6.4 Baking

This section will only apply if the HPR30 has been supplied with a bakeout jacket fitted.

Optionally, the HPR30 may be fitted with a self regulating bakeout jacket. Baking the HPR30 manifold will reduce the background contribution to the measured spectrum, particularly the levels of water.

After connecting the HPR30 manifold to the process chamber, pumping it down and leak checking we recommend baking for 24 hours. The bakeout jacket is self regulating and will maintain a high but safe bakeout temperature around the inlet manifold and mass spectrometer vacuum chamber.

7 System operation Low Pressure mode

7.1 Introduction

WARNING

- 1. This equipment must be fully installed and configured for normal operation before it is powered-up; failure to do this may cause injury to the operator and damage to the equipment.**
- 2. This equipment must be earthed; failure to do this may cause injury to the operator and damage to the equipment.**

The HPR30 system will be connected directly to the process chamber when operated in the Low Pressure mode.

CAUTION

The HPR30 System must not be moved while the turbo pump is at operational speed. Inertial shock loading of the turbo pump rotor at operational speed may cause severe pump damage. Ensure that the System is fully assembled, in the correct position, and the castors are locked before starting the turbo pump.

Please read all the Operating Manuals supplied with the HPR30 System prior to first operating the System.

7.2 Initial System set-up Low Pressure Operation

Refer to Figure 1.

1. If not already fitted, attach the RF Head to the Probe. Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual".
2. Connect the pneumatic supply for the electro-pneumatic valves. The connection is typically a 6 mm pneumatic fitting.

The supply should be air or nitrogen at a pressure of 70 to 80 psi.
3. Connect the inlet manifold to the process chamber via the CF35 Conflat flange inlet port.

WARNING

The mains power plug and socket is the primary disconnect device for the HPR30 System; it must be easily identifiable and accessible by the operator.

CAUTION

The HPR30 manifold assembly MUST be supported once it is connected to the process chamber. DO NOT rely on the CF35 Conflat flange connection

5. Connect the mains power plug to a suitable 110 V, 50 to 60 Hz socket. The mains power socket must be easily accessible by the operator.

7.3 System start-up procedure

Refer to Figures 1 and 2.

- | | | |
|----|---|--|
| 1. | Close the QIC Inlet Isolation Valve, QIC Bypass Control Valve and QIC Bypass Isolation Valve. | These valves are manually operated. |
| 2. | Close the Process valve and RGA valve. | These valves are operated by the AVC1 Controller. |
| 3. | Press the Turbo Interface Unit START button. | The vent valve will close, the membrane backing pump will start and the turbo pump will accelerate to full speed. |
| 4. | Switch on the Penning Gauge Controller once the turbo has reached full speed. | The pressure displayed will decrease as the mass spectrometer chamber is pumped-down. |
| 5. | The Mass Spectrometer may be switched on when the Penning gauge indicates a pressure less than 1×10^{-5} Torr. | Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" for operation details. |

7.4 Process Mode (1 Torr maximum)

CAUTION

1. **After the process has been at a high pressure, the volume enclosed between the orifice and Process valve may be at relatively high pressure. To avoid damage to the Mass Spectrometer, due to excess pressure, either allow sufficient time for the volume to be evacuated through the orifice, or open the Process valve whilst the HPR30 System is being pumped down.**
2. **The Mass Spectrometer must not be subjected to excessive pressure during sampling: please refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" before proceeding with the following instructions.**

Refer to Figures 1 and 2.

- | | | |
|----|--|---|
| 1. | Ensure that the QIC Inlet Isolation Valve and QIC Bypass Isolation Valve are closed. | These valves are manually operated. |
| 2. | Ensure that the Process and RGA valves are closed. | These valves are operated by the AVC1 Controller. |

3. Ensure that the process chamber pressure is in the range corresponding to the orifice fitted. See Section 9 for details.
4. Ensure that the membrane backing pump is operating and the turbo pump is operating at full speed
5. Ensure that the Penning gauge is indicating a pressure less than 1×10^{-5} Torr.

CAUTION

Ensure that the Mass Spectrometer ionisation source filaments are switched off before opening the Process valve; allow 2 minutes for the filaments to cool.

6. Open the Process valve.
7. Ensure that the Penning gauge is indicating a pressure less than 1×10^{-5} Torr.
8. Switch on the Mass Spectrometer. Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" for operation details.
9. Sample as required.
10. To end sampling, close the Process valve.

7.5 RGA Mode 1×10^{-5} Torr max.

CAUTION

1. **After the process has been at a high pressure, the volume enclosed between the orifice and Process valve may be at relatively high pressure. To avoid damage to the Mass Spectrometer, due to excess pressure, either allow sufficient time for the volume to be evacuated through the orifice, or open the Process valve whilst the HPR30 System is being pumped down.**
2. **The Mass Spectrometer must not be subjected to excessive pressure during sampling; please refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" before proceeding with the following instructions.**

Refer to Figures 1 and 2.

1. Ensure that the QIC Inlet Isolation Valve, QIC Bypass Control Valve and QIC Bypass Isolation Valve are closed. These valves are manually operated.
2. Ensure that the membrane backing pump is operating and the turbo pump is operating at full speed.
3. Ensure that the Penning gauge is indicating a pressure less than 1×10^{-5} Torr.

CAUTION

Ensure that the mass spectrometer ionisation source filaments are switched off before opening the RGA and Process valves; allow 2 minutes for the filaments to cool.

4. Open the RGA and Process valves. These valves are operated by the AVC1 Controller.
5. Ensure that the Penning gauge is indicating a pressure less than 1×10^{-5} Torr.
6. Switch on the Mass Spectrometer. Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" for operation details.
7. Sample as required.
8. To end sampling, close the RGA and Process valves.

For full details of opening and closing the Process and RGA valves either manually or automatically refer to the AVC1 manual reference HA-085-012.

7.6 System shut-down procedure

Refer to Figures 1 and 2.

1. Switch off the Mass Spectrometer ionisation source filaments. Allow a minimum of 2 minutes for the filaments to cool.
2. Switch off the Penning Gauge Controller.
3. Ensure that the Process and RGA valves are closed. These valves are operated by the AVC1 Controller.

4. Ensure that the QIC Inlet Isolation Valve and QIC Bypass Isolation Valve are closed.
5. Switch off the Turbo Interface Unit. The membrane pump will stop, the turbo pump will decelerate and the automatic vent valve will operate, after a delay period, to vent the System.
6. Disconnect power from the HPR30 System after 15 minutes.

8 System operation High Pressure mode (2 atm. max.)

8.1 Introduction

WARNING

1. **This equipment must be fully installed and configured for normal operation before it is powered-up; failure to do this may cause injury to the operator and damage to the equipment.**
2. **This equipment must be earthed; failure to do this may cause injury to the operator and damage to the equipment.**

The HPR30 manifold assembly will be attached to the sub-frame when the system is operated in the High Pressure mode.

CAUTION

The HPR30 System must not be moved while the turbo pump is at operational speed. Inertial shock loading of the turbo pump rotor at operational speed may cause severe pump damage. Ensure that the System is fully assembled, in the correct position, and the castors are locked before starting the turbo pump.

Please read all the Operating Manuals supplied with the HPR30 System prior to first operating the System.

8.2 Initial system set up High Pressure mode

Refer to Figure 1.

1. If the HPR30 is operating in the Low Pressure mode shut the system down. Follow the instructions in section 7.6.
2. If not already fitted, attach the RF Head to the Probe. Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual".

3. Connect the QIC inlet to the process chamber via the CF35 Conflat flange inlet port.

8.3 System operation High Pressure mode (100 Torr to 2 atm.)

Refer to Figures 1 and 2.

- | | | |
|----|---|--|
| 1. | Ensure that the Process and RGA valves are closed by turning the AVC1 controller Mode key-switch to STANDBY. | These valves are operated by the AVC1 Controller. |
| 2. | Open the QIC Inlet Isolation valve, QIC Bypass Control Valve and QIC Bypass Isolation Valve. | These valves are manually operated. |
| 3. | Press the Turbo Interface Unit START button. | The vent valve will close, the membrane backing pump will start and the turbo pump will accelerate to full speed. |
| 4. | Switch on the Penning Gauge Controller once the turbo pump has reach full speed. | The pressure displayed will decrease as the mass spectrometer chamber is pumped-down. |
| 5. | The Mass Spectrometer may be switched on when the Penning gauge indicates a pressure less than 1×10^{-5} Torr. | Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" for operation details. |

CAUTION

The Mass Spectrometer must not be subjected to excessive pressure during sampling: please refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" before proceeding with the following instructions.

6. Ensure that the Penning gauge is indicating a pressure less than 1×10^{-5} Torr.
7. Switch on the Capillary Temperature Controller.

8. Allow ½ hour (minimum) for the QIC inlet to heat up.

CAUTION

Ensure that the Mass Spectrometer ionisation source filaments are switched off before operating the valves associated with the QIC inlet.

CAUTION

The Sample Bypass Control valve must not be fully closed during sampling.

9. Set the pressure indicated by the Penning gauge to a maximum of 1×10^{-5} Torr by adjusting the QIC Bypass Control valve. Slowly turn the valve knob clockwise to increase the pressure at the mass spectrometer.
10. Switch on the Mass Spectrometer. Refer to Hiden Analytical Limited Manual number HA-085-014, "RC PIC Analyser Operator's Manual" for operation details.
11. Sample as required.
12. To end sampling, close the QIC Inlet Isolation Valve, then close the QIC Bypass Isolation Valve.

Before re-commencing sampling the system should be shut down, vent (see Section 8.4) and re-started (described above).

Full details of the QIC capillary inlet can be found in the manual reference HA-085-027.

8.4 System shut down High Pressure mode

Refer to Figures 1 and 2.

1. Switch off the Capillary Temperature Controller.
2. Switch off the Mass Spectrometer ionisation source filaments. Allow a minimum of 2 minutes for the filaments to cool.
3. Switch off the Penning Gauge Controller.
4. Ensure that the Process and RGA valves are closed. These valves are operated by the AVC1 Controller.

5. Ensure that the QIC Inlet Isolation Valve and QIC Bypass Isolation Valve are closed.
6. Switch off the Turbo Interface Unit. The membrane pump will stop, the turbo pump will decelerate and the automatic vent valve will operate, after a delay period, to vent the System.
7. Disconnect power from the HPR30 System after 15 minutes.

9 Changing the orifice cap

The orifice cap can be changed to suit the process pressure.

A range of sampling orifice sizes is available to suit a variety of process pressures; Table 1 details the recommended orifice size for a given maximum process pressure.

Maximum process pressure (Torr)	Recommended orifice size (mm)
1.0	0.05
5.0×10^{-2}	0.20
5.0×10^{-3}	0.70

Note:

The above values given are approximate only; the system configuration, and mass spectrometer type, may vary and may require alternative sizes for a given process pressure. If in doubt, contact Hiden Analytical Limited for advice.

Table 1 Orifice sizes

The HPR20 system must be shut down, vented and removed from the process chamber to gain access to the orifice cap.

To change the orifice cap:

1. Remove the M2x10 cap head screws (4-off) from the orifice cap flange.
2. Remove the orifice cap.

3. Check that the Viton “O”-ring is correctly seated in the mating flange.
4. Fit the replacement orifice cap in position.
5. Refit and tighten the M2x10 cap head screws (4-off).