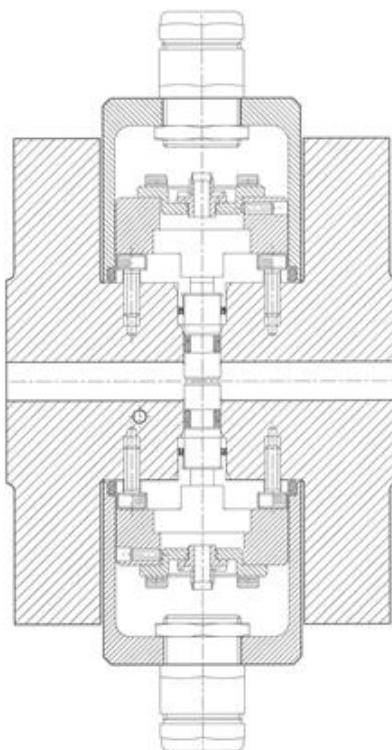


Vortex™ Process Flow Cell

User Instruction Manual



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1. Introduction

Thank you for purchasing a Specac Vortex™ Process Flow Cell.

This instruction manual is a general instruction guide designed to familiarise the user with the installation and operation of this liquid process flow cell. You may receive a particular version of process cell slightly different from standard specification and so an appropriate document will be provided for the particular Vortex.

The Vortex is designed to sample industrial fluid phase streams by means of NIR. The liquid flow cell is installed directly into the plant process flow environment as a by-pass loop allowing for real-time remote monitoring and control. The liquid sample stream flows through a particular pathlength between the sapphire windows of the flow cell. The operating temperature and pressure of your cell(s) will be specified on the laser engraved rating plate found on the cell itself.

The liquid within the flow cell is analysed by the light passing through sapphire windows and the light is bought to and from the remote process cell environment via connectivity to fibre optics. Depending on the types of fibres and spectral range of analysis.

Vortex specifications classify within the Sound Engineering Practice (SEP) classification of the Pressure Equipment Directive (PED) (2014/68/EU)

In accordance with the ATEX Directive for safe operation of equipment in specifically designated environments, the Vortex comes with a certification document explaining the “out of scope” nature of this product.

2. Specifications

The Vortex is offered to a standard specification, detailed below, but can be provided as a custom-built version for a particular application. Please, refer to the product rating plate for specific details.

Body material	316L Stainless Steel
Maximum allowable pressure	Refer to Flow Cell rating plate
Temperature range	Ambient to 200 °C
Sealing	Isolast Perfluoroelastomer
Pathlength	2 mm
Optical materials	Sapphire windows and Quartz lenses
Optical range	12000 – 4000 cm^{-1}
Fiber optic connection	SMA
Cell bore	10 mm diameter
ANSI Flange Mounting	As per design

Further options that may be included with your particular version of Vortex are as follows:

- Cleaning ports for access to window faces.
- Alternative O-ring seals to Isolast.
- Alternative fiber diameters and connectivity.
- Alternative inlet/outlet tubing connectivity.
- Alternative pathlength and cell bore size.
- Alternative material (e.g. zirconium or titanium).
- Protective hoods for fiber fittings/sealed covers and glands.

3. Safety Warnings



Vortexes that weigh in excess of 20kg should be lifted with appropriate equipment. Any attempt to lift by other means could result in personnel injury or damage to the flow cell. Learn and use safe lifting and moving techniques for heavy or awkward loads; use mechanical aids to assist in lifting.



Vortexes may see temperatures in excess of 60°C and thus it is the user's responsibility to provide suitable personnel protection and/or warning notice.



Personal protective equipment (PPE) should be provided, used, and maintained as required for the health and safety of employees. It is the user's responsibility to provide suitable personnel protection and/or warning notice.

Chemical compatibility of sealing materials is the user's responsibility. Datasheets of all included sealant material will be provided upon request.

4. Unpacking and Checklist

The Vortex is supplied in a protective transport case.

On receipt of the item/s check the following:

- Vortex has been supplied to your specification.
- Quality and Testing Documentation
- Instruction Manual.
- Letter of Compliance

Remove the items carefully from their packaging and proceed to install the Vortex per the instructions supplied.

5. Installation and Removal of the Vortex

Important note

All relevant site safety procedures should be followed during the installation and/or removal of the Vortex(s).

Only suitably qualified and experienced personnel should attempt to conduct any aspect of these instructions.

Specac Vortexes contain optical components these must not be subjected to undue mechanical shock during installation or removal.

Installation

1. Vortexes that weigh in excess of 20 kg should be lifted with appropriate equipment. Any attempt to lift by other means could result in personnel injury or damage to the flow cell.
2. It is the user's responsibility to install the Vortex in a properly designed piping system that is adequately protected from over pressure by a suitably sized protection device.

3. It is recommended that the Vortex be installed in conjunction with isolation / drain valves to facilitate safe removal of the unit for maintenance or other purposes.
4. It is the user's responsibility to ensure that the required bolting is adequate for the design conditions and bolting is tightened in the correct sequence and the required torque values.
5. The Vortex may see temperatures in excess of 60°C and it is the user's responsibility to provide suitable personnel protection and/or warning notice.
6. The Vortex should be continual monitored for potential leaks.

Removal

1. The Vortex must be isolated from the process stream, de-pressurised, purged of any process fluids or residual vapours, and allowed to cool before removal takes place.
2. It is recommended that the cell be flushed with a suitable cleaning fluid to remove all traces of process fluid prior to removal from the plant equipment.

6. Maintenance of the Vortex

The Vortexes are designed to be maintenance free under normal operating conditions. Cleaning of the sapphire windows (where a cleaning port is fitted) may be required if process debris or film causes window fouling.

Window cleaning

For units fitted with window cleaning ports, cleaning can be performed as follows:

1. The unit must be isolated from the process flow, de-pressurised, purged of any process fluids or residual vapours and flushed with suitable cleaning fluid.
2. Remove the cleaning port plug.
3. Clean the windows by gently rubbing the window surfaces with a cleaning pad attached to an insertion rod or bottle brush.
4. Inspect the seal for damage and clean where necessary. Clean sealing surfaces and replace the cleaning port plug.
5. Flush the cell with cleaning fluid and drain to remove any particulate matter generated during the windows cleaning process.

7. Recommendations during operation of the Vortex

During operation, it is the user's responsibility to:

- i. ensure that personnel operating the Vortex are adequately trained and qualified for their assigned tasks.
- ii. mandate the use of appropriate PPE (including safety glasses, gloves, lab coats, and any specialized PPE) required for specific processes.
- iii. clearly communicate any post-emergency procedures, including evacuation routes, emergency shutdown protocols, and the location of emergency tools/equipment (such as first aid kits).
- iv. provide material safety data sheet (MSDS) for all chemicals to be used in the Vortex.
- v. regularly inspect and maintain the Vortex.
- vi. ensure proper ventilation in the installation area.
- vii. establish clear communication channels for reporting safety concerns or incidents.
- viii. conduct regular safety audits and inspections to identify and address potential hazards.
- ix. conduct a thorough site assessment to identify potential hazards (e.g. hot surfaces) and ensure that the installation site meets the required specifications.
- x. review and follow the installation instructions provided by Specac.
- xi. calibrate and verify the accuracy of instruments and sensors during the installation process.
- xii. keep detailed records of the installation process, including any adjustments or modifications made.

- xiii. perform quality assurance checks at key stages of the installation process.

Calibrating the Vortex.

Chemometric analysis provides the user with diagnostic data like residuals and quality of the spectral fitting. Should these increase, it is normally a sign that the user has an issue with the Vortex (e.g. fouling) or that the composition of the process stream has changed considerably. Therefore, the user should check light throughput, residuals, and other diagnostics for the specific sample measured.

Operating the Vortex.

In Vortex, near infra-red (NIR) technique is utilized for real-time analysis of materials in manufacturing processes. A sample in a pipeline set on the process stream is interrogated by NIR light. The light is transmitted through the liquid and collected by detector within the spectrometer through the output fibre. By collecting the amount of light transmitted through the sample, prediction is made of certain concentrations or samples are identified. In other words, when NIR light is interrogating samples high in chemical compounds, some energy is absorbed by the sample in the specific wavelengths. The transmitted light thus has less intensity in these areas. The difference between these areas can be correlated to chemical concentration differences.

8. Diagram of the Vortex

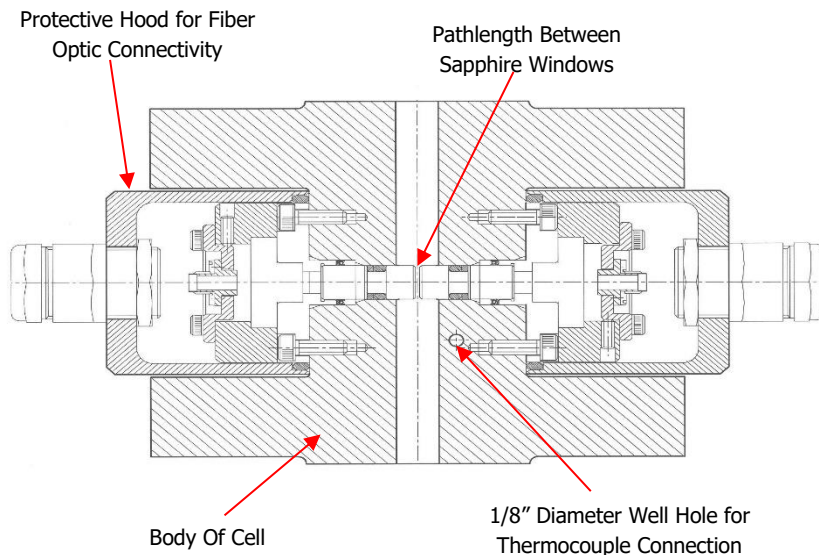


Figure 1 Sectional view of the Vortex

Figure 1. shows a sectional view of a typical Vortex. It is shown with the protective hoods (2 of them) for the fiber fittings but without the optional cleaning port connections. The position of the thermocouple well hole is also shown (centrally in the cell body).

The body of the cell has been cutaway to show the internal distance between the window faces for the pathlength of the flow cell

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