PATsmart™ FlowVPX® Single-Use Flow Cells, X-ray Irradiated

Regulatory Support File

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Abbreviations

CFU	Colony Forming Units
EU	Endotoxin Units
SAL	Sterility Assurance Level
USP	United States Pharmacopeia
VD_{max}	Maximal Verification Dose

1. Introduction

The Regulatory Support File (RSF) for PATsmart™ FlowVPX® Single-Use Flow Cells from Repligen's Analytics business unit is intended to be used as:

- a guide for appropriate application use in process development, clinical, and commercial processes
- a reference source for users to validate their manufacturing processes.

Repligen is committed to providing all relevant technical, manufacturing, and quality information; however, only non-confidential information is presented in this document. Confidential details may be made available upon request through a formal confidentiality agreement or as part of a supplier audit.

1.1 Repligen's Corporate Quality Policy

Repligen has a firm commitment to:

- Customer satisfaction, ensuring focus on meeting or exceeding product & service requirements,
- Comply with legal, customer and other applicable requirements,
- Continual improvement of our Quality Management System.

1.2 Safety notices

- Follow all local regulations for safe disposal.
- Use products for laboratory and manufacturing production only.

1.3 Responsible Official

Correspondence regarding quality and regulatory affairs at Repligen's Analytics business or requests for audits should be addressed to:

Director of Quality
Email: analytics-support@repligen.com
Telephone: +1 908-707-1009

1.4 Where to Receive Help

If you wish to know more about this product or variable pathlength technology, contact a Repligen analytical specialist or our customer support team. Customer support information is located on page 2 of this document.

1.5 Quality Standards

Since product quality is essential to our customers' success, Repligen makes quality assurance a top priority. Repligen's Analytics business has implemented a Quality Management System in compliance with ISO 9001:2015. ISO certificate is available upon request.

1.5.1 Certificates

Repligen's Analytics business unit supplies Certificates of Conformance and Certificates of Material with released manufacturing lots. Certificates are included with individual FlowVPX Single-Use Flow Cells. A sample of the certificate package is included in section 7.2.

2. Product Overview

2.1 Product Description

The FlowVPX Single-Use Flow Cells are designed to provide an in-line measurement solution compatible with the FlowVPX variable pathlength system. The FlowVPX System uses unique, patented variable pathlength technology (VPT) to unlock the power of Slope Spectroscopy® measurement methods for highly regulated drug manufacturing processes.

Constructed with a polyphenylsulfone (PPSU) body, it comes with standard tri-clamp connections with AseptiQuik® connectors to allow for easy connections. The unit also goes through a validated x-ray irradiation process prior to shipment to achieve a sterility assurance level (SAL) of 10^{-6}. The FlowVPX Single-Use Flow Cell utilizes a modular mating surface to fit onto the FlowVPX Detector Module and VPX Head. It was designed with a precision ethylene propylene diene monomer (EPDM) diaphragm seal, which forms a barrier around the integral Flow Fibrette® Optical Component to ensure a contained process-measurement area. Additionally, each Flow Cell is equipped with Smart Technology, which directly communicates with the FlowVPX Head and provides valuable information for traceability. FlowVPX Single-Use Flow Cells are alternatives to stainless steel FlowVPX Flow Cells and deliver comparable performance.

2.2 Product Family Definition

The following part numbers are included in the FlowVPX Irradiated Single-Use Flow Cell family:

- OC2008-XR – FlowVPX 3mm Single-Use Flow Cell, X-ray Irradiated
- OC2009-XR – FlowVPX 10mm Single-Use Flow Cell, X-ray Irradiated
- OC2010-XR – FlowVPX 22mm Single-Use Flow Cell, X-ray Irradiated
- OC2014-XR – FlowVPX 0.5 in Single-Use Flow Cell, X-ray Irradiated
- OC2016-XR – FlowVPX 1 in Single-Use Flow Cell, X-ray Irradiated

Figure 1. Example of FlowVPX Irradiated Single-Use Flow Cell.

2.3 Materials of Construction

The FlowVPX Single-Use Flow Cell is designed to use USP Class VI materials on all process contact parts.

Table 1. Process-contact materials

Component	Material
Flow Cell body	Polyphenylsulfone (PPSU)
Tri-clamp gasket	Platinum-cured silicone
AseptiQuik® fitting	▪ OC2008-XR, OC2009-XR, OC2010-XR: Polycarbonate ▪ OC2014-XR, OC2016-XR: PPSU All items: platinum-cured silicone seal
Fibrette diaphragm	EPDM
UV window	Fused silica
UV window gasket	EPDM
Fibrette probe	SS316L sleeve, fused silica fiber optic, medical-grade epoxy

Metallic process contact surfaces are fabricated with 316L-type stainless steel as described in the ASME BPE standard, with finishing specifications for electropolished or passivated surfaces meeting ASTM B912 or ASTM A967 standards. Certificates verifying such specifications were provided by the suppliers of the applicable components.

The process contact surface finishes are designated as SFP5 (Ra ≤ 50 µin or 1.27 µm) for polymeric materials and SF5 (Ra ≤ 20 µin or 0.51 µm) for metallic materials as described in the ASME BPE standard.

Table 2. Non-process-contact materials

Component	Material
Sanitary Clamp	Glass-filled nylon
Screws	SS316/SS316L
Sealant	Viton sealant
Electrical contact	Gold-plated contacts
Electrical contact substrate	Torlon PAI
AseptiQuik® membrane	Hydrophobic polyethersulfone with PTFE strip membrane
Epoxy	Medical-grade epoxy

2.4 Product Specifications

Table 3. Product specifications

Product ID	OC2008-XR	OC2009-XR	OC2014-XR	OC2010-XR	OC2016-XR
Flow Path Diameter	3.0 mm	9.5 mm	12.7 mm	22.1 mm	26.6 mm
Flow Cell Body Material	PPSU	PPSU	PPSU	PPSU	PPSU
Tri-Clamp Connection	1/4 in	3/4 in	3/4 in	1.5 in	1.5 in
AseptiQuik® Fitting	AQS33004HT	AQG33012HT	AQG33112	AQL33024HT	AQL33124
Dimensions	187 x 210 x 74 mm (7.4 x 8.3 x 2.9 in)	204 x 204 x 73 mm (8.0 x 8.0 x 2.9 in)	204 x 208 x 81 mm (8.0 x 8.2 x 3.2 in)	255 x 229 x 81 mm (10.0 x 9.0 x 3.2 in)	276 x 231 x 109 mm (10.9 x 9.1 x 4.3 in)
Weight	340 g (0.75 lb)	360 g (0.79 lb)	360 g (0.79 lb)	646 g (1.42 lb)	660 g (1.5 lb)
Maximum Pathlength	3.000 mm	5.000 mm	5.000 mm	5.000 mm	5.000 mm
Maximum Cycle Count*	150,000				
Maximum Lifetime Operation	30 days				
Maximum Pressure	4.1 bar (60 psi)				
Maximum Operating Temperature	40°C (104°F)				
Minimum Operating Temperature	4°C (39°F)	1°C (34°F)	1°C (34°F)	1°C (34°F)	1°C (34°F)
Maximum Holdup Volume	2.9 mL	24.6 mL	31.1 mL	109.4 mL	145.6 mL
Dead Leg Study L/D Value	0.31	0.09	0.09	0.31	0.23
Instrument Compatibility	FlowVPX Instrument (IN-VPX-FLOW-A)				
Storage Conditions	5°C–25°C (41°F–77°F), <70% relative humidity, non-condensing. Store with seals intact and protected from UV light and ozone.				
Irradiation Process	X-ray, 20.0–36.0 kGy				

**A cycle is defined as one Quick Slope measurement or one Fixed Slope measurement sequence.*

2.5 Product Contents

- One FlowVPX Single-Use Flow Cell, X-ray Irradiated
- Certificate of Conformance
- Certificates of Material

3. Important information before you begin

3.1 Intended Use

FlowVPX Single-Use Flow Cells are to be used only with the FlowVPX System.

3.2 Unpacking and Installation

FlowVPX Single-Use Flow Cells are double bagged and vacuum sealed and should contain no air inside the bags upon delivery. The bags should be opened inside a controlled environment to prevent contamination.

3.3 AseptiQuik® Connector Best Practices

Every FlowVPX Single-Use Flow Cell comes equipped with AseptiQuik® connectors.

1. Snap both sides to make sure that both halves are parallel to each other (Figure 2).

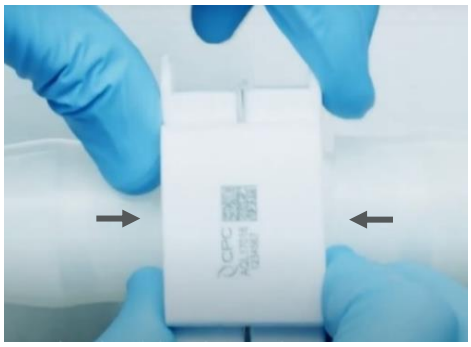


Figure 2. Snapping together the connector.

2. Ensure that the tabs are snapped together to eliminate the risk of accidentally pulling one tab individually (Figure 3).

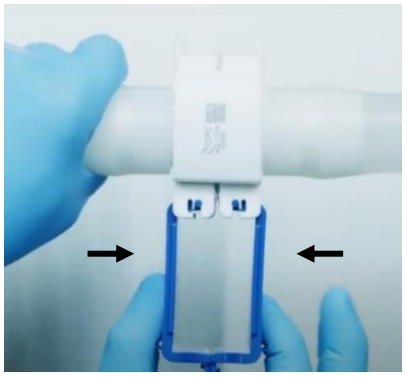


Figure 3. Snapping the tabs together.

Note: *Connected halves forming a V or snaps that are not flush indicate one side is not fully connected (Figure 4).*

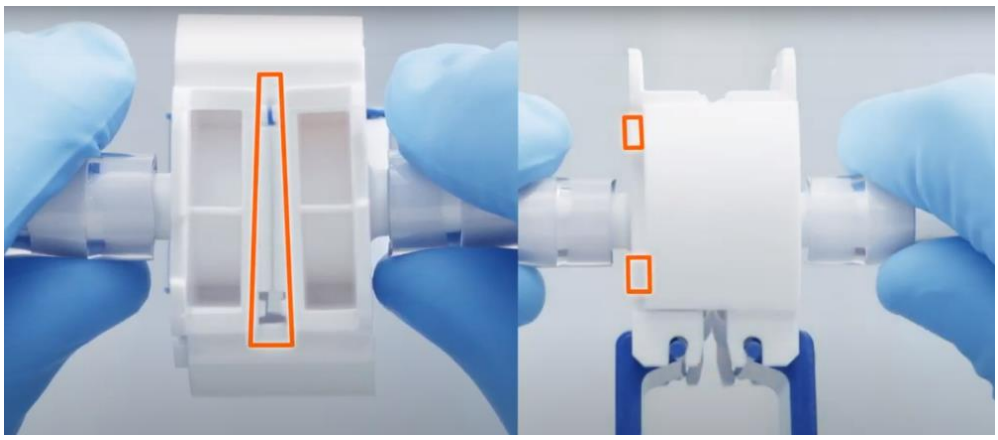


Figure 4. Examples of INCORRECT AseptiQuik® connected halves. Left: halves and tabs not flush against one another; right: gaps present.

3. To remove the membranes, hold the outside of the connector, place a finger through the connected tabs, and pull directly away from the connector (Figure 5). Be sure not to pull the tabs at an angle, twist the tabs, or squeeze the connector set together while pulling the tabs.

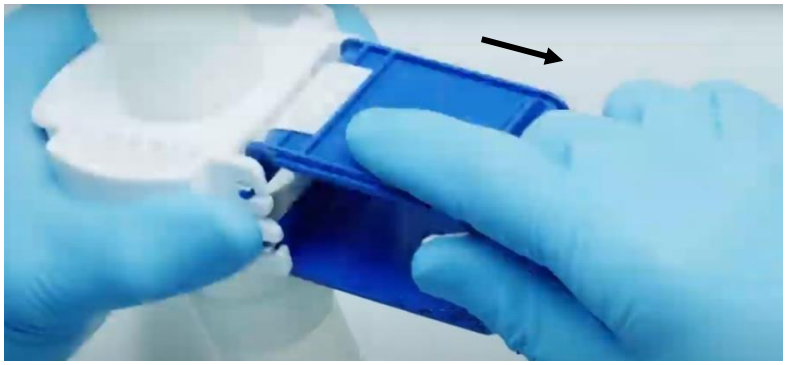


Figure 5. Removing the membranes by pulling the tabs.

For additional information on AseptiQuik® connectors, please see the manufacturer's website at cpcworldwide.com

3.4 Storage conditions

FlowVPX Single-Use Flow Cells must remain in their original vacuum-sealed packaging prior to use to maintain their characteristics and integrity and to prevent contamination. Below are critical factors to remember when storing unused FlowVPX Single-Use Flow Cells.

Recommended storage conditions:

- 5°C–25°C (41°F–77°F)
- <70% Relative Humidity (RH), non-condensing
- Store with seals intact and protected from UV light and ozone

The packaged Flow Cell is in contact with the following materials:

- 3D-printed acrylonitrile butadiene styrene (ABS)
- Acrylic tube
- Aluminum standoff
- Stainless steel screws & inserts
- Nylon screws

3.5 Flow Cell Serial Number

The serial number for each Single-Use Flow Cell is found on the side of the Flow Cell body (Figure 6).

Figure 6. Single-Use Flow Cell serial number

4. Product performance

4.1 Establishment of Maximum Dose of Irradiation

Maximum dose was established through an accelerated aging study with samples irradiated at a minimum of 40 kGy and tested at 0, 1, and 2 year timepoints. The delivered irradiation dose of 40 kGy ensured samples were irradiated at or above the specified range of 20–36 kGy.

4.2 Fibrette Diaphragm Lifetime Actuation After Irradiation

Functionality was tested at temperature and pressure extremes of the EPDM diaphragm seal after x-ray processing. The goal for testing was to determine if the diaphragms can withstand exposure to x-ray irradiation while maintaining functional performance at extremes of specification. The samples were x-ray processed at ≥40 kGy and tested for lifetime actuation under 60 psi pressure at 1°C, 40°C, and ambient temperature.

4.2.1 Lifetime Actuation Test: Procedures

- The test samples were exposed to ≥40 kGy x-ray irradiation.
- The integrated Fibrette Optical Components were actuated over the full range for up to 500,000 cycles.
- The actuation was performed under 60 psi pressure.
- Each actuation cycle consists of successive 0.5 mm steps downward and a full stroke upward to simulate the real use case of the FlowVPX System during data collection. It takes 5 seconds to finish each actuation cycle.
- The lifetime is recorded as the cycle count when there is leak observed, or 500,000 if no leak is observed.

Table 4. Fibrette Lifetime Test Conditions

Condition	Hot	Cold	Ambient
Temperature	40°C	1°C	Ambient
Relative humidity	50%	Ambient	Ambient
Pressure	60 psi	60 psi	60 psi

4.2.2 Lifetime Actuation Test: Conclusion

All units completed a greater number of cycles than the lifetime specification of the Flow Cells. Based on the test results, the longevity of the Single-Use Flow Cells was not impacted by x-ray irradiation. PATsmart ViPER® ANLYTX Software will display a warning once the Flow Cell reaches the maximum number of actuations.

4.3 FlowVPX Single-Use Flow Cell SmartCell Chip Irradiation Compatibility

The SmartCell chip installed in each FlowVPX Single-Use Flow Cell holds unit-specific information for traceability purposes. The chips are read by the FlowVPX Head when installed in the instrument.

The memory of the SmartCell chips was checked after irradiation and verified to hold data accurately.

4.4 Flow Fibrette Optical Component Transmittance Test

Irradiation-resistant materials were selected for the Flow Fibrette Optical Component used in Single-Use Flow Cells.

4.4.1 Transmittance Test: Procedures

The test units were exposed to x-ray irradiation of at least 40 kGy to represent the worst-case scenario for x-ray exposure. Each Fibrette was tested for transmittance before and after x-ray irradiation.

4.4.2 Transmittance Test: Results

The test results show no impact on transmittance above 300 nm and a slight decrease in transmittance below 300 nm (Figure 7). However, all samples maintained transmittance over 70% at 260 nm, compared to transmittance before irradiation of 80% at 260 nm.

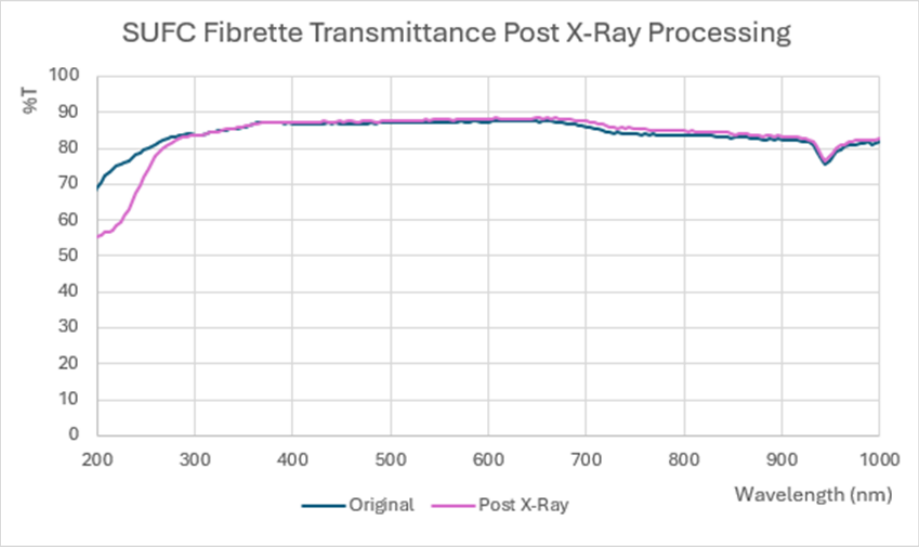


Figure 7. Flow Fibrette Optical Component transmission after x-ray processing

4.4.3 Transmittance Test: Conclusion

X-ray irradiation was found to have negligible impact on the transmittance of the Flow Fibrette Optical Component.

4.5 Leak Test

A test lot of the irradiated Single-Use Flow Cell were pressurized to 60 psi and then isolated from external pressure and held at 60 psi for five minutes. The measured decrease in pressure after 2 minutes was <1 psi for all items tested.

4.6 Slope Test

The FlowVPX Single-Use Flow Cells were tested for slope reading accuracy after irradiation. Control measurements were made using the FlowVPX Stainless Steel 10 mm Flow Cell. The 0.5 in Single-Use Flow Cell was tested without irradiation; the design and materials are similar to the 10 mm Single-Use Flow Cell and results after irradiation are expected to be the same.

The test was conducted using PATsmart ConfiRM® Slope Reference Materials at three different slope (Abs/mm) values.

4.6.1 Slope Test: Results

Table 5. Slope test

Product ID	Flow Path	Body Material	Irradiation	0.1 Abs/mm	23 Abs/mm	46 Abs/mm
OC2008-XR	3 mm	PPSU	≥40 kGy	PASS	PASS	PASS
OC2009-XR	10 mm	PPSU	≥40 kGy	PASS	PASS	PASS
OC2010-XR	22 mm	PPSU	≥40 kGy	PASS	PASS	PASS
OC2016-XR	1 in	PPSU	≥40 kGy	PASS	PASS	PASS
OC2014*	0.5 in	PPSU	None	PASS	PASS	PASS
OC2001**	10 mm	316L Stainless Steel	None	PASS	PASS	PASS

*Part no. OC2014 was tested without irradiation. The design and materials of construction are similar to the 10 mm Flow Cell and results after irradiation are expected to be the same.
**Stainless Steel Flow Cell part no. OC2001 is included for reference only.

4.6.2 Slope Test: Conclusion

The data demonstrated that none of the following has a negative impact to the function of the Single-Use Flow Cells:

- the body material (PPSU or 316L stainless steel),
- size of flow path,
- irradiation process, and
- concentration of sample.

4.7 Shelf Life Testing

Shelf life testing with 1-year and 2-year accelerated aging was conducted on product irradiated at or above 40 kGy to demonstrate that the components remain fit for use over time. Each test used 6 units of OC2008-XR, 3 units of OC2009-XR, and 3 units of OC2010-XR. The test units were aged according to ASTM F1980-21 guidelines. The units were then tested for:

- Pressure leak
- Flow Fibrette transmission
- SmartCell chip reading by FlowVPX Head
- Slope accuracy at 0.1 Abs/mm, 23 Abs/mm, and 46 Abs/mm
- Fibrette diaphragm lifetime actuation at 1°C and 40°C

A 2-year real-time aging study was conducted using part no. OC2009-XR. The test units were irradiated at or above 40 kGy and then stored for 2 years prior to testing. The units were then tested for:

- Vacuum seal integrity (visual inspection)
- Pressure leak
- Flow Fibrette transmission
- Slope accuracy at 0.1 Abs/mm, 23 Abs/mm, and 46 Abs/mm
- Fibrette diaphragm lifetime actuation at 1°C and 40°C

4.7.1 Shelf Life Test: Conclusion

All test units meet the functional specifications after 1-year accelerated aging, 2-year accelerated aging, and 2-year real-time aging as described above.

5. Safety information

5.1 USP Class VI

The purpose of USP Class VI classification is to verify the biological safety of each of the polymeric process contact components used in the FlowVPX Single-Use Flow Cell. Details of requirements for this classification can be found in USP <88> Biological Reactivity Tests, In Vivo. All process contact parts of the FlowVPX Single-Use Flow Cells are USP Class VI-compliant. Certificates stating USP Class VI classification were provided by the suppliers of the polymeric process contact components.

5.2 Extractable Study

A controlled extraction study was conducted on the body of the FlowVPX Single-Use Flow Cell (OC2010-XR) following BioPhorum Operations Group (BPOG) guidance (BioPhorum Best Practices Guide for Extractables Testing of Polymeric Single-Use Components Used in Biopharmaceutical Manufacturing, April 2020) by a GLP/GMP-compliant analytical and bioanalytical contract testing laboratory.

The extractions were done by incubation at 40 ± 3°C with continuous agitation at 50 RPM, with the following solvents:

- water for injection (WFI),
- 0.5 N sodium hydroxide solution (0.5 N NaOH),
- 0.1 M phosphoric acid solution (0.1 M H_3PO_4), and
- 50% ethanol solution (50% EtOH).

The flow cell was extracted by filling the sample with the appropriate extraction solvent. The time points evaluated were 24 ± 4 hours and 21 ± 1 days.

The sample extracts were analyzed for:

- volatile organic extractables by headspace gas chromatography (GC) with mass spectrometry (MS),
- semi-volatile organic extractables by direct injection GC-MS,
- non-volatile organic extractables by ultra-performance liquid chromatography (UPLC) with photodiode array (PDA) and quadrupole time-of-flight mass spectrometry (QToF) detectors, by both APCI and ESI, and
- inorganic extractables by inductively coupled plasma (ICP) with MS detection (except for the 50% EtOH extracts).
- In addition, the WFI extracts were also analyzed for pH and total organic carbon (TOC).

5.2.1 Extractable Study: Conclusion

For the WFI extracts, there were 4 volatile organic extractables, 1 semi-volatile organic extractable by APCI, 10 non-volatile organic extractables by ESI and 9 inorganic extractables observed at or above the reporting threshold. The pH values for the 24-hour time point were 4.92 and 4.91 for the control and the sample extracts, respectively. The pH values for the 21-day time point were 5.35 and 4.35 for the control and the sample extracts, respectively. In addition, the TOC results were 2.660 µg/cm^2 and 4.252 µg/cm^2 for the 24-hour and 21-day time point, respectively.

For the 0.1 M H_3PO_4 extracts, there were 7 volatile organic extractables, 3 semi-volatile organic extractables, 2 non-volatile organic extractables by APCI, 4 non-volatile organic extractables by ESI and 12 inorganic extractables observed at or above the reporting threshold.

For the 0.5 N NaOH extracts, there were 5 volatile organic extractables, 3 semi-volatile organic extractables, 3 non-volatile organic extractables by APCI, 20 non-volatile organic extractables by ESI and 2 inorganic extractables observed at or above the reporting threshold.

For the 50% EtOH extracts, there were 8 volatile organic extractables, 19 semi-volatile organic extractables, 21 non-volatile organic extractables by APCI and 67 non-volatile organic extractables by ESI observed at or above the reporting threshold.

5.3 Endotoxin Test

This Bacterial Endotoxins Test (BET) methodology detects and quantifies endotoxin on the basis of a clot-producing reaction proportional to the interaction of Limulus Amoebocyte Lysate (LAL) and endotoxin. The test is conducted in accordance with USP <85> Bacterial Endotoxin via the gel clot method.

The test article fulfills all acceptance criteria and does not inhibit nor enhance the Bacterial Endotoxins Test. The geometric endpoint concentration of the test article extract was <0.06 EU/mL and it contained <7.4 EU/device of bacterial endotoxin.

The endotoxin level of the FlowVPX Irradiated Single-Use Flow Cells meets the <20 EU/device requirement of USP <85> for medical devices, excluding devices that contact cerebrospinal fluid or the intraocular environment. Endotoxin monitoring is achieved by testing the Master Product (see section 5.4.1) every 3 months.

5.4 Sterility Assurance Level (SAL) Validation

5.4.1 Selection of Test Article (Master Product)

The Master Product, OC2010-XR, was selected to represent the FlowVPX Single-Use Flow Cell Family. OC2010-XR was determined to be “worst case” challenge to the sterilization process through bioburden studies comparing the bioburden levels of each product. All Single-Use Flow Cells have the same overall structure, materials, and packaging design; the differences between models are the size of the flow path and aseptic connectors, which do not present a significant difference in the bioburden challenge. Three different Flow Cell models showed equivalent bioburden levels in a validated laboratory test (section 5.3). Products were dose mapped at the radiation test lab of Steris and showed similar and consistent dose distributions. The routine processing dose is established to be 20.0–36.0 kGy.

5.4.2 Sterility Validation

The dose establishment for the fluid path of the FlowVPX Single-Use Flow Cell Family was conducted in accordance with ANSI/AAMI/ISO 13004:2022 VDmax20 to provide a Sterility Assurance Level (SAL) of 10^{-6} for a minimum irradiation dose of 20.0 kGy. The VDmax20 method requires a bioburden of ≤45.0 CFU/device. The validation was conducted utilizing the Master Product OC2010-XR.

Table 6. Sterilization validation summary

Summary of VDmax20 Validation	
Validation Method	VDmax20
Substantiated Minimum Dose	20 kGy
Average Corrected Bioburden	<4.0 CFU
10^{-1} Verification Dose	4.9 kGy
Test of Sterility	0 growth
Sterility Assurance Level (SAL)	10^{-6}

5.4.3 Quarterly Audits

Continued effectiveness of the established dose is demonstrated through quarterly dose audits conducted in accordance with ISO 13004.

5.5 Particulates Test

This study was conducted based on USP <788> Particulate Matter in Injections. 40 mL of purified water was flowed through each test article. The eluent together with a control solution of purified water were analyzed using a particle measuring system. Particle counts were measured using channel settings (particle size) of 10, 25, and 100 µm. The differential count results were recorded directly from the instrument.

All units passed the acceptance criteria of 0 particles/unit at the 100 µm particle size.

6. Manufacturing Process Validation

6.1 Manufacturing Facilities

All FlowVPX Single-Use Flow Cells are manufactured at 685 Route 202/206, Bridgewater, NJ 08807. Quality control (QC) is also based in this location. FlowVPX Single-Use Flow Cells are manufactured in an ISO Class 7 clean room.

6.2 Manufacturing Controls and SOPs

Training: Manufacturing is performed by qualified and trained operators. Training documentation is maintained by Quality Assurance.

Process documentation: Repligen manufacturing processes are governed by an ISO 9001-compliant quality management system. All manufacturing work instructions are contained in controlled documents. Manufacturing processes are 100% traceable through an internal lot numbering system. All manufacturing data are recorded by operators at the time of manufacturing. Batch records are archived for three years on site and then stored off site for a minimum of 10 years.

Raw materials and components: All raw materials are controlled, and each raw material has a preapproved specification. Receipt of material is verified and released by QC prior to use in manufacturing.

Supplier management: Repligen identifies critical suppliers of raw materials and components based on the impact to the quality of the product. Critical suppliers are subject to a qualification process and are monitored and routinely audited according to a pre-determined schedule. The supplier audit schedule is established based on a critical supplier audit cycle, supplier performance, past audit results and business requirements.

Change management: Manufacturing process changes are governed by change management procedures that include provisions for customer notification of major changes.

Product storage control: Product is stored at ambient temperature.

Preventive maintenance and calibration: Equipment and monitoring devices are controlled through the Repligen equipment control process. Each piece of equipment is uniquely identified and has a preventive maintenance and/or calibration schedule, as necessary.

Business continuity policy: The Repligen Corporation Business Continuity Management System (BCMS) is designed to maintain the continuity of critical business activities in the case of an emergency and/or an event that severely impacts business operations and ultimately the ability to supply product. Such events may include operational incidents, un-forecasted product demand, man-made or environmental incidents or threats, and natural disasters. Proper maintenance and application of BCMS processes will allow for

the control and restoration of business practices in an acceptable amount of time to maintain product reliability and mitigate the possibility of a product shortage.

Packing environment and environmental controls: All FlowVPX Single-Use Flow Cells are packed in ISO Class 7 clean rooms.

7. Release Testing

7.1 Quality Inspection

Initial inspection of the unit starts with a member of the quality control (QC) team inspecting the body of the unit for any defects. The unit should be free of dents, chips, scratches, excess glue, etc. There should be no foreign objects inside of the unit which may prevent the Fibrette Optical Component from moving up and down.

The inspector checks the window for cleanliness. It should be covered with blue tape for protection. The inspector removes the tape and checks the unit for scratches, chips, debris, and checks the smart chip for excess glue.

The inspector performs pressure testing according to work instructions.

The inspector checks the AseptiQuik® connectors with tri-clamp to verify that they are secure and oriented as per the work instructions. The clamps should be fully tightened so that there are no gaps.

After the unit is packaged and vacuum sealed, the inspector checks the unit to ensure it is sitting in the box and sealed with the serial number facing upwards. The inspector verifies that the information on the label placed on the box is correct and contains the serial number, work order number, date of manufacture (D.O.M.), etc. If any unit fails any part of inspection at any point prior to irradiation, it is recorded and returned to manufacturing for rework. Once the unit passes the QC check, results are recorded, and the unit is put into inventory.

After irradiation, the inspector checks the Certificate of Processing and the irradiation indicator to verify that the unit passed. The Flow Cell is visually inspected to ensure the product is not damaged and the packaging is intact. A label is applied to indicate the final part number ending in -XR and the lot number used for irradiation.

7.2 Certificate Package

Repligen supplies certificates of analysis for released manufacturing lots. Example certificates for the FlowVPX Single-Use Flow Cell are shown on the following pages.

Certificate of Conformance

Manufacturer:	Repligen Corporation	**Date Irradiated:**	2-Jun-2025
Part ID:	OC2009-XR	**Lot No.:**	98765432
Description:	**CTech™ FlowVPX® Single-Use 10 mm GxP Flow Cell**	**Run ID:**	1234-5678
		Serial No.:	*X09-1111 - FX09-2222*

Repligen Corporation certifies that this product received its irradiation dose as specified below.

The fluid path of the single use flow cell has been validated following ANSI/AAMI/ISO 13004 guidelines for VDmax20 to provide a minimum Sterility Assurance Level (SAL) of 10-6 for an established irradiation dose.

Edna Ramos **Quality Control Manager**	2-Jun-2025 **Date**

CF0644 eRev. 01 02-Jun-2025

REPLIGEN
INSPIRING ADVANCES IN BIOPROCESSING

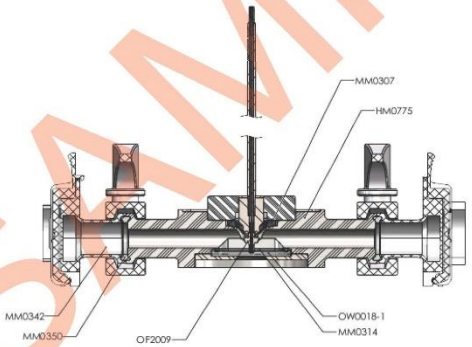
Certificate of Material

Manufacturer:	Repligen Corporation	**Date of Manufacture:**	27-May-2025
Part ID:	OC2009-XR	**Lot No.:**	12345678
Description:	**CTech™ FlowVPX® Single-Use 10 mm GxP Flow Cell**	**Process Order No.**	9876-5432
		Serial No.:	*X09-9999 - FX09-9999*

Repligen Corporation certifies that raw materials of process-contact components are compliant with composition, biocompatibility, and surface finish requirements according to ASME BPE 2022 standards and the applicable associated standards referenced therein.

Materials of Construction (Process Contact):

Part ID	Description	Material Type
MM0342	AseptiQuik® Connector	Polycarbonate Body, Platinum-Cured Silicone Seal
MM0350	Tri-Clamp Gasket	Platinum-Cured Silicone
OF2009	GxP Fibrette Assembly	See OF2009 Certificate of Material
MM0307	Fibrette Diaphragm	EPDM (USP Class VI Approved)
HM0775	10 mm SUFC Body	PPSU (USP Class VI Approved)
OW0018-1	UV Window	Fused Silica Window
MM0314	Window Gasket	EPDM (USP Class VI Approved)



For complete Material Certificates of process-contact components, please contact a Repligen analytical specialist at analytics-support@repligen.com

Edna Ramos
Quality Control Manager

27-May-2025
Date

CF0471 eRev. 06 27-May-2025

REPLIGEN
INSPIRING ADVANCES IN BIOPROCESSING

Certificate of Material

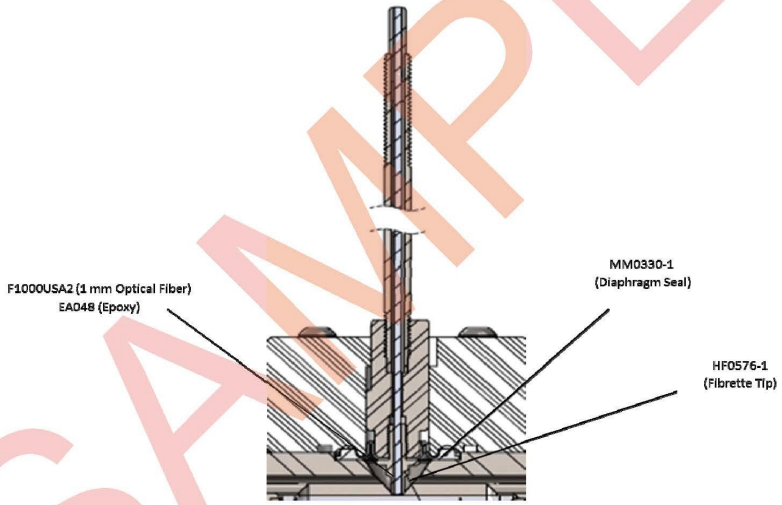
Repligen Corporation
685 Route 202/206,
Bridgewater, NJ
USA 08807

Manufacturer:	Repligen Corporation	**Date of Manufacture:**	21-May-2025
Part ID:	OF2002-1	**Lot No.:**	IW12787-01
Description:	**CTech™ FlowVPX® 3mm Flow Fibrette**	**Process Order No.**	IW12787-01
		Serial No.:	*FX02-1596*

Repligen Corporation certifies that raw materials of process-contact components are compliant with composition, biocompatability, and surface finish requirements according to ASME BPE 2022 standards and the applicable associated standards referenced therein.

Materials of Construction (Process Contact):

Part ID	Description	Material Type
MM0330-1	Fibrette Diaphragm	EPDM (USP Class VI Approved)
HF0576-1	Flow VPX Flow Cell 3 mm Fibrette Tip	316 L—Stainless Steel - .8 RA
F1000USA2	UV Grade Optical Fiber	Fused Silica
EA048	Medical Grade Epoxy	USP Class VI & FDA Approved



For complete Material Certificates of process-contact components, please contact a Repligen analytical specialist at analytics-support@repligen.com

Edna Ramos
Quality Control Manager

21-May-2025
Date

CF0490 eRev. 05 10-Jun-2025

REPLIGEN
INSPIRING ADVANCES IN BIOPROCESSING

Certificate of Material

REPLIGEN
INSPIRING ADVANCES IN BIOPROCESSING

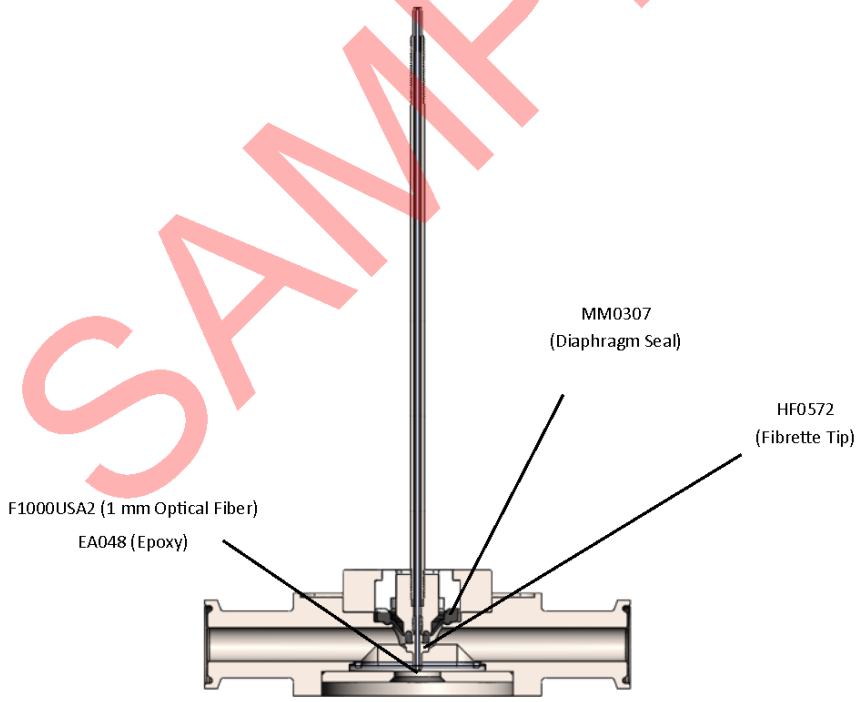
Material and Surface Finish

Part ID **OF2001**

Description: **CTech FlowVPX 10 mm GxP Fibrette**

Item No.	Part No.	Description	Material Type	Surface Finish
1	MM0307	Flow Cell Fibrette Diaphragm Seal	EPDM Class VI	N/A
2	HF0572	Low VPX Flow Cell 10 mm GxP Fibrette Tip	316 L—Stainless Steel	8 RA
3	F1000USA2	1.000/1.050/1.250 MM S UV-.22NA	Core: High-OH/Doped Silica Clad	N/A
4	EA048	EP42HT-2Med Epoxy	USP Class VI Approved	N/A

OF2001—CTech FlowVPX 10 mm GxP Fibrette



CF0388 Rev. 02 04/12/2021

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8. References

1. ASME BPE—American Society of Mechanical Engineers, Bioprocessing Equipment, An International Standard
2. ASTM B912—Standard Specification for Passivation of Stainless Steels Using Electropolishing
3. ASTM A967—Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
4. USP <88> Biological Reactivity Tests, In Vivo
5. BPOG—BioPhorum Best Practices Guide for Extractables Testing of Polymeric Single-Use Components Used in Biopharmaceutical Manufacturing: 2020; Scott, Ullsten, Wang, Hathcock, Madsen, Dale, Wong, et.al.
6. ANSI/AAMI/ISO 11137-1, 2006 /(R2015) /A2:2019 - Sterilization of Health Care Products – Radiation – Part 1: Requirements for Development, Validation, and Routine Control of a Sterilization Process for Medical Devices
7. ANSI/AAMI/ISO 11737-1:2018 - Sterilization of Health Care Products – Microbiological methods – Part 1: Determination of the Population of Microorganisms on Product
8. ISO/IEC 17025, 2017, General Requirements for the Competence of Testing and Calibration Laboratories
9. USP-NF 2023. <85> Bacterial Endotoxins Test
10. USP-NF 2023. <161> Medical Devices – Bacterial Endotoxin and Pyrogen Tests
11. Limulus Amoebocyte Lysate (LAL), Pyrotell® Kit Instruction (Associates of Cape Cod Inc.)
12. USP-NF 2002. <71> Sterility Tests
13. ISO 13004: 2022 - Sterilization of health care products – Radiation – Substantiation of selected sterilization dose: Method VDmaxSD
14. AAMI TIR35:2006 - Sterilization of health care products – Radiation sterilization – Product adoption and alternative sampling plans for verification dose experiments and sterilization dose audits
15. USP-NF 2024 <788> Particulate Matter in Injections

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