



CUSTOM SENSORS & TECHNOLOGY

A DIVISION OF CUSTOM SAMPLE SYSTEMS

CST BIOPROCESSING PRODUCTS & APPLICATIONS OVERVIEW

WHO WE ARE & WHAT WE DO FOR BIOPROCESSING

For over 45 years, Custom Sensors & Technology (CST) has been a trusted leader in process analytical technology (PAT), serving the biopharma and biotech industries. As PAT becomes increasingly vital for real-time quality assurance, CST continues to lead the way—delivering innovative solutions that enhance process control, ensure compliance, and boost product yield. Our ongoing commitment to adaptability drives the development of cutting-edge products that meet the evolving needs of today's fast-growing life sciences sectors. CST's robust process photometric transmitters, inline probes, low cells, and pressure sensors empower users to achieve superior process control and product quality.

PX2+ & PX2-DIN

Designed for continuous process monitoring, the PX2+ and PX2-DIN are ideal for applications such as chromatography, tangential flow filtration (TFF), depth filtration, centrifugation, fill and finish operations, and fermentation.

The PX2+ is available in single or dual-wavelength configurations and supports a wide range of light sources—from 200 to 2400 nm—for both absorbance and fluorescence measurements. In most biomanufacturing environments, both models utilize long-life LEDs at 260, 280, 300, 310, and/or 880 nm for dependable, real-time monitoring.

Purpose-built for absorbance applications, the PX2-DIN offers reliable, high-performance measurements using LED light sources in a compact design for DIN rail mounting. Communication with the transmitters is seamless via one or two 4–20 mA outputs, RS-485 (Modbus), or USB-B connection to CST's proprietary software. The PX2-DIN can be used with an optional remote panel mount display.

Installation is straightforward, with both models typically paired with a process interface accessory—such as a probe or flow cell—and connected via two fiber optic cables that transmit and receive light to and from the sensor.



Measurement Range: 0-3 AU

Accuracy: $\pm 1\%$ of full scale or better from 0-2 AU, $\pm 2\%$ from 2-3 AU

Repeatability: $\pm 0.5\%$ of full scale or better

Wavelength Range: 200-2400 nm

LED Wavelengths: 260, 280, 300, 310, and 880 nm (other wavelengths available upon request)

Other Light Sources: Xenon Flash Lamp, Tungsten Halogen Lamp

Analog Output: 4-20 mA, isolated

Digital Output: RS-485 (Modbus)

Power Requirements: 24 VDC nominal (12-48 VDC)

Response Time: 1 second or less
PX2+ includes 3.2" touchscreen display

PHOTOMETRIC PROCESS MONITORING ACCESSORIES

CST offers a full product line of photometric process monitoring accessories to be used with the PX2+ and PX2-DIN including the Single-Use Process Flow Cell, patented EZ-CAL Flow Cell, Variable Path Length Cross Flow Cells and Sanitary Cross Flow Cells, Transmission Probes, Fluorescence Probes, Fiber Optic Cables, Cuvette Holders, and ND Standards.

The Single-Use Process Flow Cells are molded in a ISO Class 7 cleanroom from USP Class VI polypropylene.

All reusable Flow Cells and Probes can be constructed from 316SS, Hastelloy C-276, Titanium, Monel, PEEK, or other materials upon request. Sealing material options include Viton (FKM), Kalrez (FFKM), or EPDM that meet USP Class VI requirements.



FLOW CELLS

1. Single-Use Process Flow Cell and Holder

- Available with 1/2" hose barb and sanitary connections.
- Optical Path Length: 1 mm, 2 mm, 5 mm, 10 mm
- The Process Flow Cell Holder allows for integration into process and simple inline validation/calibration.

2. EZ-CAL Flow Cell

- The patented 3/8" EZ-CAL extractive flow cell gives users an integrated means of calibration.
- Solid standards or cuvettes can be inserted into the optical path of the flow cell to make calibration and validation procedures simple.

Available with sanitary flanges

- Optical Path Length: 1-100 mm

3. Variable Path Length Cross Flow Cells & Sanitary Cross Flow Cells

- These can be provided with several different connection/flange options for 1/8", 3/8", 1/2", or 3/4" tubing.
- Optical Path Length: 0.1-10 mm

PROBES

4. Transmission Probes

- Standard probe insertion length of 220 mm (custom lengths available).
- Optical Path Lengths: 1-20 mm

5. Front Surface Fluorescence Probes

6. FIBER OPTIC CABLES

7. CUVETTE HOLDERS & NEUTRAL DENSITY STANDARDS

SINGLE-USE AND REUSABLE PROCESS PRESSURE SENSORS & TRANSMITTERS

Process Pressure Sensors are intended for measuring the dynamic and static pressures of liquids and gases for both single-use and reusable bioprocessing applications including tangential flow filtration (TFF), bioreactor pressure monitoring, and depth filtration monitoring. A standard M12 connector integrates directly to our PT1 (single channel) and PT4 (four channel) transmitters that include 4-20 mA, Modbus RTU, TMP outputs, and optional remote display. CST also offers M12 adapter cables for use with existing 3rd party transmitters.



1. Single-Use Process Pressure Sensors

- Available Hose Barb Connections: 1/4", 3/8", 1/2", 3/4"
- Available Sanitary Connections: 1/2", 3/4"
- Pressure Range: -10 to 100 psi
- Material: Polypropylene (USP Class VI)

2. Reusable Process Pressure Sensors

- Available Hose Barb Connections: 1/8", 1/4", 3/8", 1/2", 3/4"
- Available Sanitary Connections: 1/2", 3/4", 1"
- Pressure Range: -10 to 100 psi
- Material: 316SS or PEEK
- Minimum of five autoclaves before easy sensor cap assembly replacement

3. PT1 and PT4 Pressure Transmitter

- Accepts 1-4 pressure sensors, transducers, and/or load cell inputs
- Outputs: 4-20mA, Modbus (auto-detect baud rate), TMP
- Sensor and Module Electrical Connections: M12 (adapter cables available)
- LED Indicator for Function & Sensor Connected Status
- Mounting Style: DIN Rail Mount

4. Remote Display

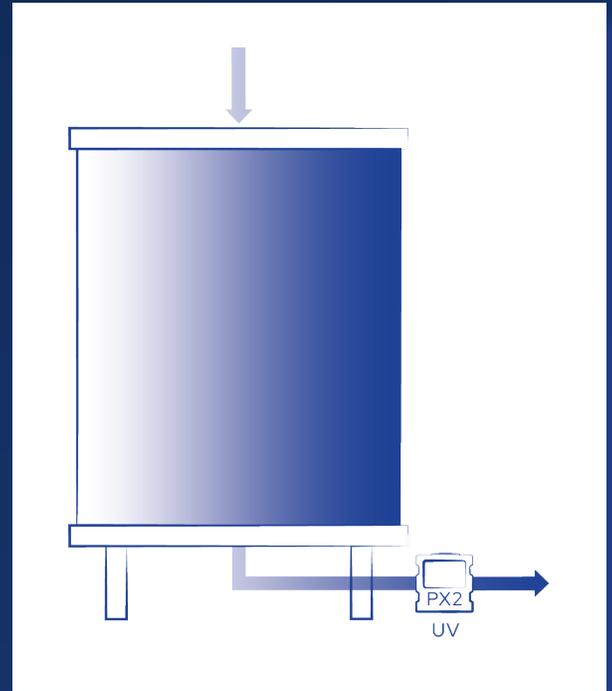
- Optional NEMA4 remote panel mount color touch screen display for PT1 and PT4
- Available in stainless steel or Cerakote aluminum

5. M12 Cable

- Sensors and Transmitters use standard M12 4-Pin Cables.

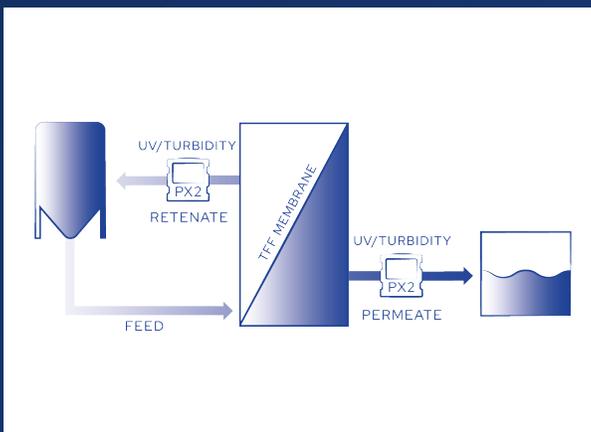
CHROMATOGRAPHY (A280, 260/280 NM, 280/300 NM)

The PX2 UV absorbance sensor delivers accurate, real-time data for post-column monitoring in protein A chromatography. Designed to streamline downstream purification, it features a convenient contact closure for zeroing on the buffer background and can be configured as either a single-channel (280 nm) or dual-channel (260/280 nm, 280/300 nm, or 280/310 nm) system. The 280 nm channel is ideal for detecting low protein concentrations during pooling, while the 300 nm or 310 nm channel extends the measurable range for high-concentration samples—up to 350 mg/mL or more. Dual 260/280 nm detection provides insight into protein purity and nucleic acid contamination, while an the 880 nm PX2 monitors turbidity and resin performance. The PX2 supports every stage of your chromatography workflow—equilibration, load, wash, elution, and cleaning—enhancing process efficiency and eliminating the need for offlinctesting when paired with our flow cells or probes.



The Process Pressure Sensor can be utilized after the pump, before the injector, and post-column.

TFF/CROSSFLOW FILTRATION/ULTRAFILTRATION/ DIAFILTRATION (UV & TURBIDITY)



Tangential Flow Filtration (TFF), also known as Crossflow Filtration or UF/DF (Ultrafiltration/Diafiltration), is a fast and effective technique for separating and purifying biomolecules. Unlike traditional filtration, TFF directs fluid parallel to the membrane surface, enabling continuous operation and consistent performance.

The PX2 UV absorbance sensor enhances TFF workflows by providing real-time monitoring of product protein or mRNA levels in both the retentate and permeate streams. A 280 nm PX2 installed on the permeate line detects low protein concentrations and identifies potential filter breakthrough. Meanwhile, a dual-wavelength 280/310 nm

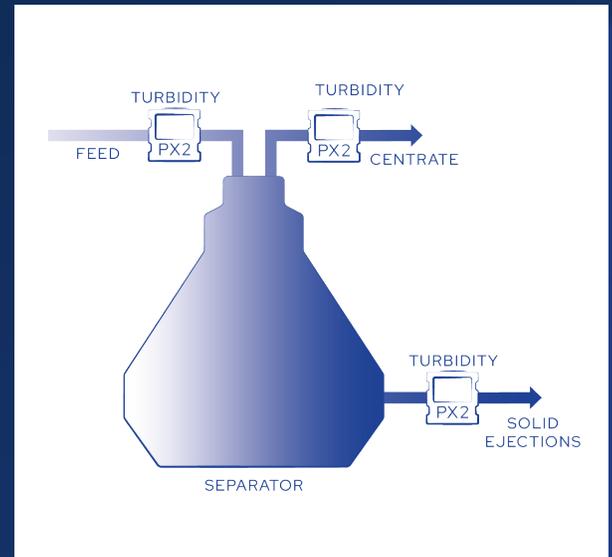
PX2 on the retentate loop tracks high protein concentrations without the need for manual sampling. This setup improves process control, increases efficiency, and ensures reliable product recovery.

The Process Pressure Sensors can be utilized on the inlet stream, permeate, and retentate for TMP monitoring.

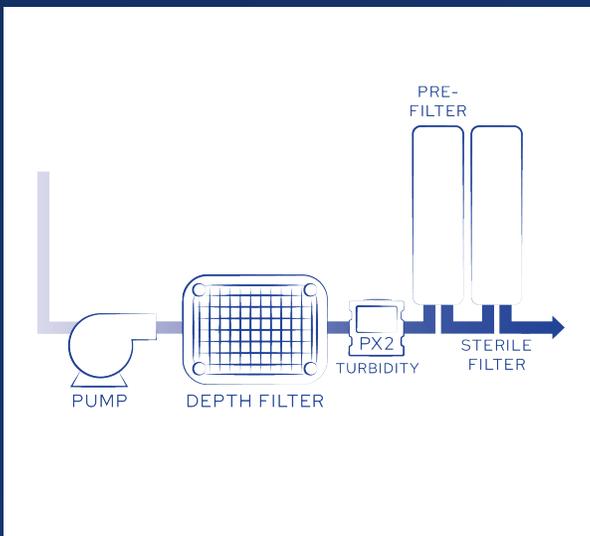
CENTRIFUGATION (TURBIDITY)

In downstream chromatography, centrifugation is used to clarify feed streams by removing large cells and debris. The 880nm PX2 sensor enhances this step by monitoring turbidity at the centrifuge outlet, providing real-time insights into performance. By measuring forward light scattering, the PX2 helps reduce product loss, improve consistency, and maintain yield. Continuous turbidity monitoring ensures that only properly clarified feed enters the next purification stage, supporting a stable and efficient downstream process.

The Process Pressure Sensor can be installed on the feed line to ensure stable and consistent feed delivery. They can also be installed after the centrifuge to verify proper flow and detect for blockages.



DEPTH FILTRATION (TURBIDITY)



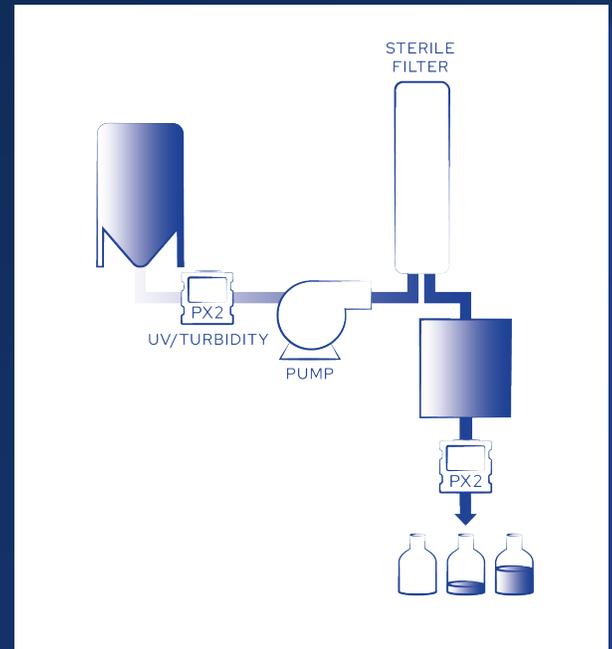
Depth filtration removes small particulates and aids in purification of a feed stream. The depth filter collects small particles by size exclusion and adsorption preventing disruption to downstream chromatography processes. Process efficiency and throughput can be improved by utilizing the 880 nm PX2 sensor. The 880 nm PX2 can detect when particles and cellular debris begin to break through the depth filter, giving operators real-time indication of the filter's performance and retention capacity.

The Process Pressure Sensor can be installed prior to the depth filter, pre-filter, and sterile filter to monitor performance, maintain process control, and ensure product quality.

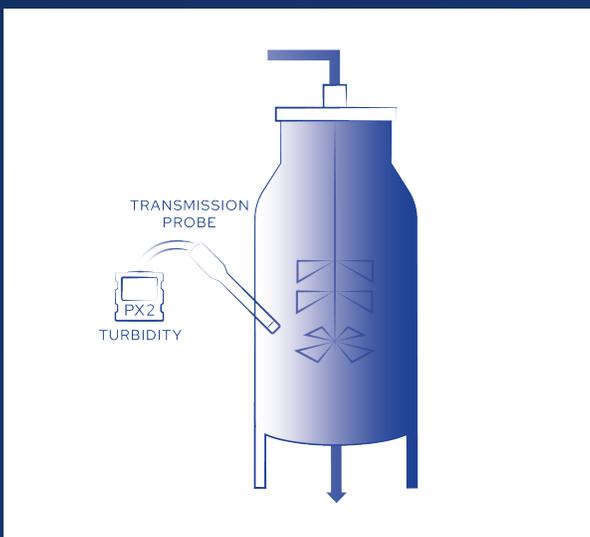
FILL & FINISH (UV & TURBIDITY)

Special processes, procedures, and equipment are required to ensure product integrity during fill and finish operations. The PX2 can monitor UV absorbance, color, or turbidity of the final product, essentially eliminating the need for visual inspections. The PX2 greatly improves process efficiency and consistency of the final product.

The Process Pressure Sensor plays a critical role in ensuring quality and control throughout fill and finish operations. Installed both upstream and downstream of the sterile filter, they monitor pressure differentials to verify filter integrity and performance. Positioned after the sterile holding vessel, these sensors provide precise pressure readings just before the product enters the final container—supporting accurate, consistent fill volumes.

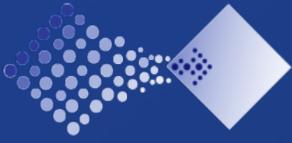


FERMENTATION (TURBIDITY)



Installing the 880 nm PX2 with CST's robust process transmission probe directly into a fermenter or bioreactor gives operators real-time indication of cell growth. As product leaves the fermenter or bioreactor, turbidity is monitored to detect unclarified material. This increases efficiency by eliminating the need for offline testing. Available with various path lengths and insertion lengths, CST has the appropriate probe for any process.

The Process Pressure Sensor can be integrated directly into the fluid or gas lines to provide real-time pressure readings to monitor and control flow, filter integrity, and overall system performance.



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