

# TOP 5 Biotech Applications

**optek**<sup>®</sup>  
inline control

**english**

deutsch

español

portuguese

русский язык

中文

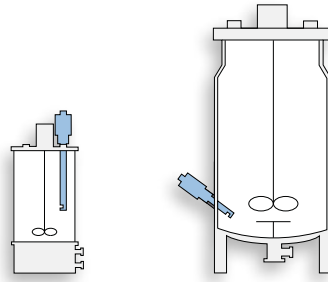
日本語

français

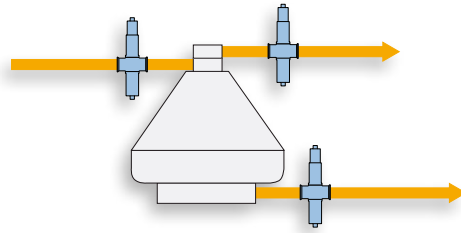
italiano



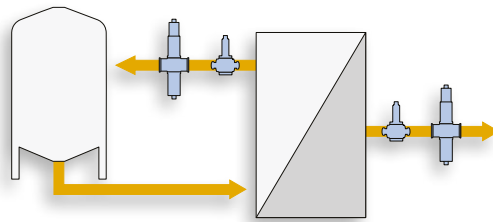
## TOP 1 Fermentation



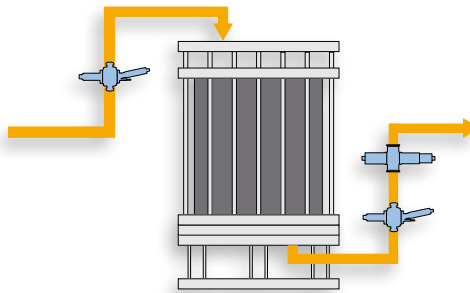
## TOP 2 Centrifuge Control



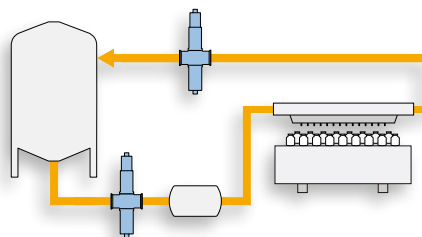
## TOP 3 Ultrafiltration



## TOP 4 Chromatography



## TOP 5 Formulation and Filling



For over 30 years, optek has focused on measuring process liquids through their interaction with light in facilities all over the world. Although global, optek remains a family owned company with a team of more than 100 qualified, customer-driven professionals.

Our confidence is born from experience. With the expertise of more than 30,000 installations worldwide, our value to the customer resides in providing a superior product that pays back. High quality materials withstand the toughest process conditions including aggressive media, high temperature, and

high pressure applications. Cleanability is ensured using high quality wetted materials, superior design, as well as sapphire optical windows.

As a global partner to various industries, optek offers the most advanced technologies including superior signal amplification, inline calibration support, PROFIBUS® PA, FOUNDATION™ Fieldbus and multilingual user interfaces for easy onsite operations.

Our support ensures long term satisfaction with programs such as “Speed-Parts” and “SwapRepair” to provide our

customers sustainable operations and minimized downtime at the lowest cost of ownership.

Conformity to international (ISO 9001), industry-specific (FM/ATEX approval) or company standards is easily achieved with optek. Wherever process composition is controlled, the name optek has become synonymous with world-class products and support.

**Optimize your process  
with optek inline control.**



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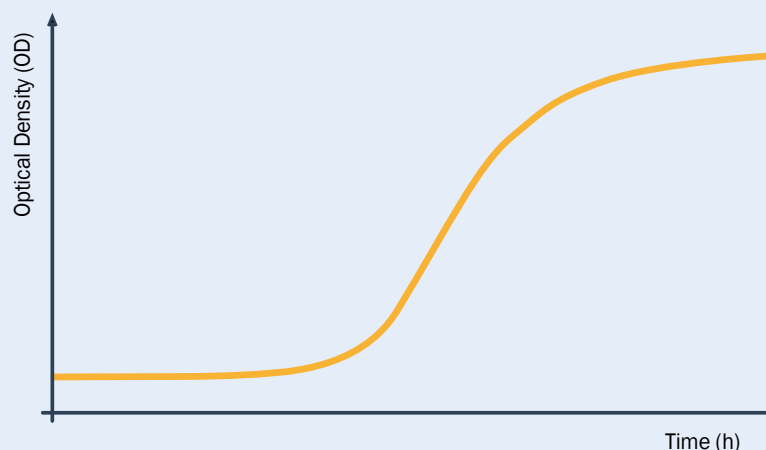
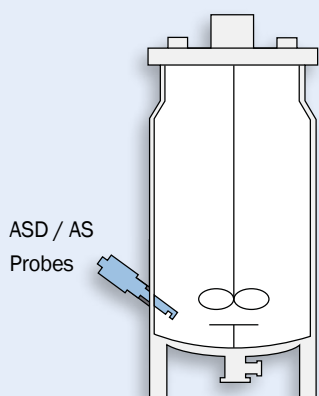
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## 04 | Fermentation



### Probe Sensors

The optek probe series of bioprocess analyzers were designed specifically to easily integrate into bioreactors and fermenters. These precise systems provide the user with a powerful tool to characterize cell growth in the laboratory and large scale cell culture and fermentation. The real-time biomass concentration is measured as a function of NIR absorption, which is less sensitive to air bubbles and coating than backscattering instruments.

Reliable in-process measurements greatly reduce sampling time and risk of contamination during offline analysis.

### Lab/Process Development

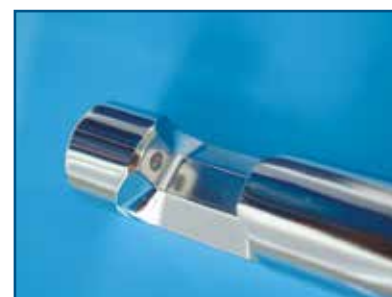
ASD12 series probes are designed for smaller scale bioreactors used in R&D and process development areas. Extremely repeatable and easy to use, ASD12 come in a variety of insertion depths and optical path lengths to give the best resolution possible.

The seal-less sapphire window design of all AS/ASD probes eliminates crevices and gaps to ensure the highest level of sterility. Additionally ASD12 probes are autoclavable.

### Pilot Scale/Manufacturing

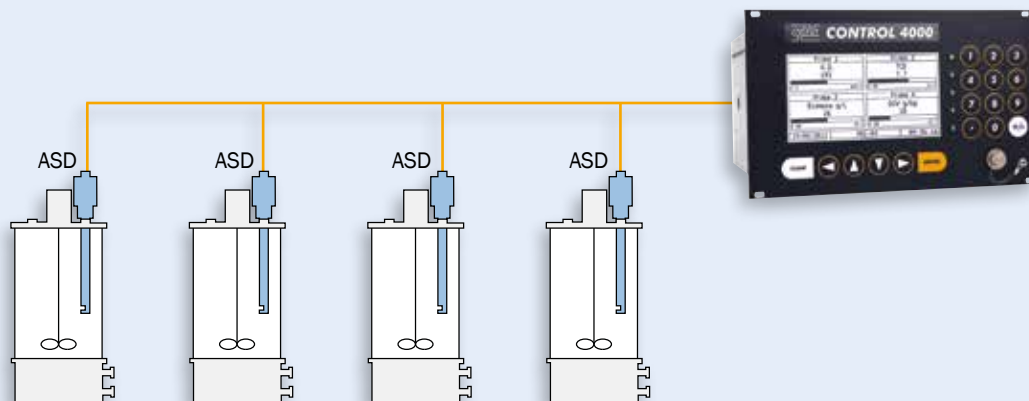
The ASD25 probes are designed for use in pilot or production scale fermentors or bioreactors. The hybrid LED light source allows for up to four ASD25 probes to be monitored from one C4000 converter. These extremely durable probes are designed for sanitary bioprocess environments and can be used in CIP/SIP processes.

Developed for larger scale reactors the AS16 series probes offer the user the same type of probe used in process development for the manufacturing scale. Depending on the point of installation, AS16 series probes are available with different insertion lengths for installation flexibility. Optional NIST-traceable calibration accessories are available for quality control checks before each process run.



optek AS16-N Single Channel Absorption Probe

**See our product information brochure C4000/C8000 for further details**



## Lab/Manufacturing C4000 Photometric Converter

The advanced modular design of the Control C4000 converter enables precision process monitoring with multiple sensors.

From laboratory to production, the C4000 can operate up to four ASD series probes simultaneously. The results are displayed in any laboratory unit, such as OD, AU, TCD, cell count, wet or dry weight. Due to the superior principle of NIR absorption, stability and measurement reliability are provided even in systems with a high degree of aeration and agitation.

For manufacturing, one Control C4000 converter can operate up to two AS16 series probes and can be panel mounted or installed in a stainless steel or plastic housing to ensure IP ratings up to IP66.

The C8000 Universal converter is installed if pH/conductivity and absorption measurements are required. Providing excellent flexibility, each C8000 converter can operate up to two ASD probes together with two pH probes and two conductivity sensors simultaneously.

Where space or implementation is an issue, ask optek for the solution.



optek C4000 Photometric Converter

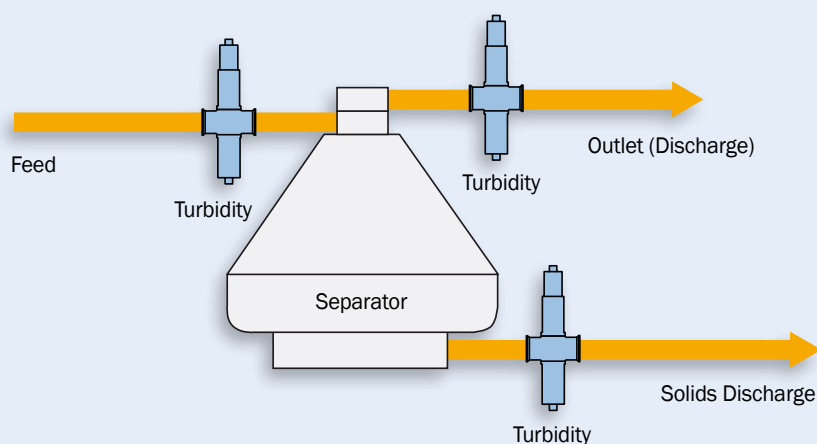
12 mm



optek ASD12-N  
Single Channel Absorption Probes



## 06 | Centrifuge Control



Installation of optek sensors at the inlet and at the outlet of a centrifuge greatly improves separation performance, reduces losses and improves product consistency.

### Feed/Inlet

The feed often has high variable solids loading. Separation efficiency can be greatly improved by installing an optek AF16-N or AS16-N prior to the separator. The separator feed rate can then be optimized based on real-time solids concentration measurements.

Flow may be adjusted to meet system requirements for optimized performance and prevent overloading or clogging of the separator.

### Outlet (Discharge)

The separator outlet (discharge) is the most common point of installation for process photometers. Monitoring at this point can help to maximize the efficiency of the system. Some systems control discharge based on time parameters set from the previous run, which is only valid with an average constant feed load.

A more efficient approach is to control the discharge based on need, which can be monitored by an optek inline sensor. Using an optek turbidity sensor to control the discharge by need, the number of discharge cycles can be reduced significantly. This increases yield, ensures consistency downstream, reduces mechanical wear, and helps avoid "blinding" of downstream filters.

Typically for cell culture processing, an optek TF16-N scattered light sensor is installed to ensure immediate detection of lowest concentrations. An optek AF16-N absorption sensor is commonly used for higher density fermentation processing.

### Solids Discharge

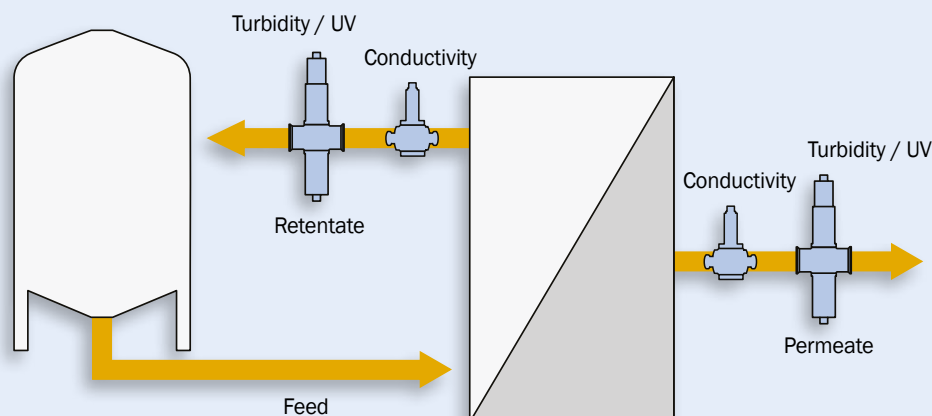
When measuring the absorption in the solids discharge stream of the separator, an optek sensor equipped with a small optical path length will accurately correlate absorption measurements directly to weight-percent. This enables accurate yield measurement and control of product quality.



optek C4000 Photometric Converter



optek TF16-N Scattered Light  
Dual Channel Turbidity Sensor



In a typical UF process, two installation points are usually considered.

## Permeate

Using an optek AF45 UV sensor on the permeate stream allows the user to ensure filter integrity, increase throughput and minimize product losses.

Identification of trace contaminants in low ppm ranges and detection of filter breakthrough in real-time ensures process consistency, while eliminating sample collection for laboratory analysis.

## Retentate

An optek AF45 or AF46 UV sensor is an ideal way to monitor the concentration of proteins during the filtration process. The sensor is installed in the return line to the recirculation tank. Real-time concentration readings up to high OD levels can be measured and trended without violating the integrity of the system and without wasting product through sampling.

## Conductivity

optek CF60 or ACF60 conductivity sensors can be installed in the permeate or retentate line to ensure proper process control.

These conductivity sensors feature a superior six-electrode, four-pole design. The patented arrangement of the four current electrodes around the two potential electrodes results in a reliable and precise measurement of a broad conductivity range.

This unique design also provides greatly reduced sensitivity to sensor fouling and polarization. Designed for ultra-sterility, the six electrodes are sealed in the FDA/USP Class VI compliant PEEK sensor tip without the use of O-Rings or epoxies.

## Converters C4000/C8000

optek converters allow the operation of multiple sensors.

The C4000 is typically used if only optical instruments are required and is able to operate two turbidity or UV measurements for permeate and retentate control simultaneously.

The C8000 is installed if turbidity or UV sensors are required along with electro-chemical measurements such as pH and/or conductivity.

**See our product information brochure C4000 / C8000 for further details.**

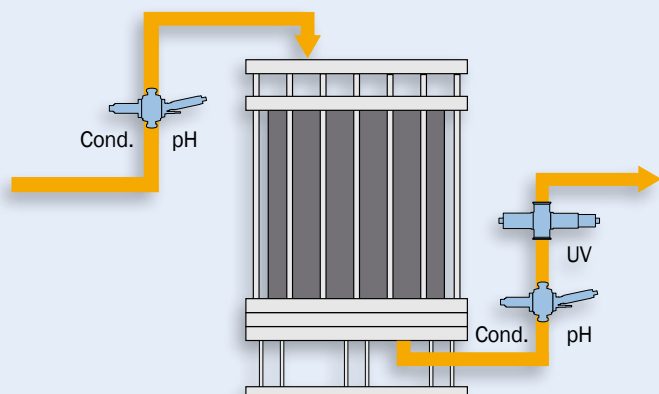


Patented Six-Electrode  
Four-Pole Conductivity Sensor



optek CF60/ACF60 Conductivity Sensor  
mounted on a Biotech Armature

## 08 | Chromatography



Protein purification in biotechnology usually requires one or more liquid chromatography steps during downstream processing.

optek inline photometric and electrochemical sensors are designed specifically for real-time measurement and control. This improves chromatographic separations by generating consistent and repeatable data to allow more discrete pooling criteria for maximizing yields and improving quality.

### Pre-Column Chromatography Monitoring

An inline ACF60 conductivity sensor, which includes a temperature sensor, and the PF12 pH sensor give real-time measurements of conductivity, temperature and pH.

### Post-Column Chromatography Monitoring

Accurate, reliable and repeatable post-column measurements are necessary during purification to ensure accurate pooling to maximize yields and protein/DNA fraction purity.

Mounted directly inline in the column outlet stream, an optek single wavelength AF45 or dual wavelength AF46 UV sensor can improve the efficiency of the separation process. This ensures product purity and greatly reduces off-line testing and manual analysis.

A NIST-traceable filter package allows users to calibrate the sensors inline in a quick and repeatable manner (see page 12 for further details).

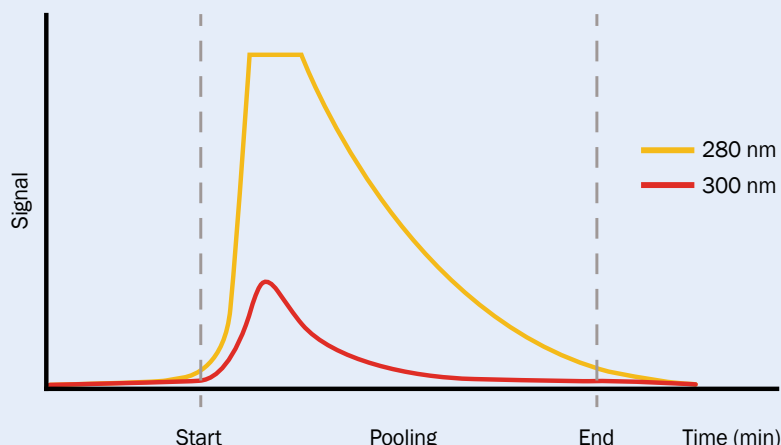
The patented six-electrode, four-pole conductivity sensor ACF60 and a PF12 pH sensor monitor the process while being mounted in a single optimized flow cell with low hold-up volume. A wide measuring range of the conductivity sensor allows monitoring transitions between buffers and control of the cleaning process, while a PF12 sensor is used for adjustment of the gel packing by means of the pH value. Additionally, equilibration methods are monitored and column integrity is ensured.

**See our product information brochure C4000 / C8000 for further details.**



optek AF46-VB Dual Channel  
UV-Absorption Sensor with Calibration Adapter





## Dual Wavelength

The primary wavelength measures concentration of protein at e.g. 280 nm for pooling purposes. Using the secondary wavelength measuring e.g. at 300 nm simultaneously, this signal is used to achieve readings even at the highest concentration ranges.

Dual-wavelengths provide precise resolution at low OD (Optical Density) to start or stop collection of the fraction using 280 nm. A high-range secondary wavelength is used to monitor elution at the highest OD ranges.

Measurements at wavelengths 254/280 nm assess purity level and nucleic acid (DNA/RNA) contamination of protein. Due to the modularity of optek inline sensors, different optical path lengths (OPL) are possible. Depending on concentration range required, the OPL and the wavelength combination are specified to achieve the highest repeatability and linearity.

## C8000 - 8 measurements taken from 5 sensors with 1 high precision converter

In a chromatographic separation skid the following measurements are required:

### PRE-Column:

combined in one sensor body for low hold-up volume

- conductivity (optek ACF60)
- temperature (optek ACF60)
- pH (optek PF12)

### POST-Column:

combined in two sensor bodies for low hold-up volume

- dual channel UV (optek AF46)
- conductivity (optek ACF60)
- temperature (optek ACF60)
- pH (optek PF12)

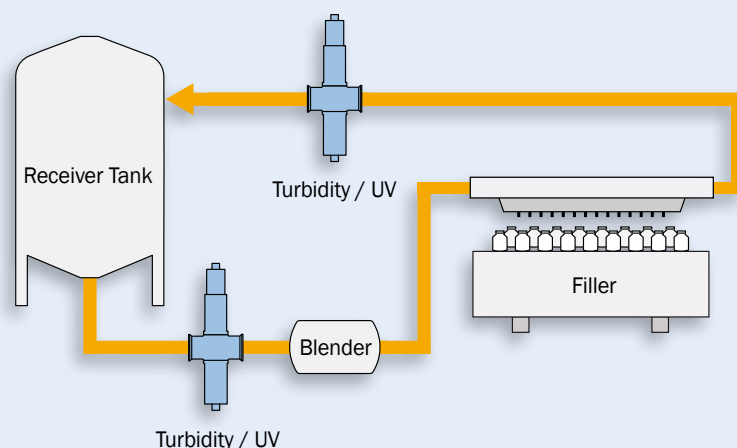


optek C8000 Universal Converter



optek ACF60 Conductivity Sensor and PF12 pH Electrode Adapter mounted on a Biotech Armature

## 10 | Formulation and Filling



Formulation and filling areas can see inconsistencies due to mixers, tank levels, pump cycling, pH and temperature variations, and even lab variances. optek sensors help operators and quality areas get a live view of inconsistencies and either make changes to help meet acceptance windows or stop a non-conforming product lot from going forward. This will help in avoiding additional costs with process knowledge to prevent lot failures.

Installing optek sensors inline help to improve consistency, conformity and productivity. An optek AF16-VB-N monitors the product concentration of suspensions to ensure stable levels during the filling process. Sensors are either installed directly in tanks or in feed or outlet process streams, as well as at the filling stations for verification.

Depending on the product, optek inline sensors can monitor for turbidity, color, dilution target, or even opalescence in biologics.

Providing quality with a live data record for the entire batch leads to optimal QA/QC for documentation and process knowledge.

### Turbidity

Many products have a base turbidity that relates to the product concentration. optek turbidity sensors have a wide dynamic range and accurately measure low to high concentration ranges.

### Dilutions

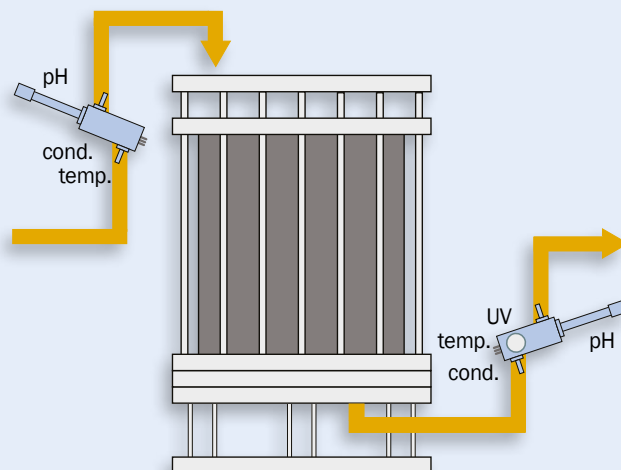
Certain products that contain turbidity will be diluted to attain the proper target dosage. optek inline sensors monitor the transition and verify the target dosage is being met before going to the filling stations.

### Opalescence/Haze

Some biologics that are stored in a vessel prior to going to filling stations acquire a phenomenon called "opalescence". This usually is a non-desired effect caused by temperature drift. It is mostly aesthetic in nature and usually does not affect potency of the drug. However, certain companies will disqualify production lots due to this undesired effect. optek UV or scattered light sensors are able to monitor opalescence occurring on a small scale. This alerts the operators immediately, preventing product losses while ensuring product quality.



optek AF16-VB-N Single Channel Absorption Sensor with Calibration Adapter



## Chromatography and Ultrafiltration Monitoring

The Single Use Cell (S.U.C.) is designed to optimize separation, purification, concentration and formulation processes in disposable chromatography and ultrafiltration systems. In applications where hazardous materials such as cytotoxic drugs or other potent biological materials are being processed, optek Single Use Cells offer additional protection for operators who are isolated from these hazards.

Having the same performance characteristics as standard reusable systems, but with a reduced hold-up volume, the S.U.C. is easy to install and is fully compatible with the optek range of UV, NIR and color absorption sensors. Additionally, NIST-traceable calibration accessories provide absolute measurement confidence (for details refer to page 12).



Fully Assembled optek SUC27 for UV, Conductivity, pH and Temperature Measurements.

## S.U.C. Benefits






The optek S.U.C. offers several significant advantages over the standard reusable stainless steel systems:

- **Reduced hold-up volume**
- **No contamination risk**
- **No cleaning or validation**
- **Improved productivity due to simpler exchange procedures and low down time between products/batches**
- **Up to six measurements in one S.U.C.**
- **Hose Barb or Clamp connections, line sizes from 1/4 in. to 1 in. available on all S.U.C. models**

## S.U.C. Design

The versatile design of the optek S.U.C. has been developed to meet the specific demands of biopharmaceutical manufacturing. Depending on the S.U.C. design chosen a maximum of five measurements are possible with one S.U.C. (conductivity, UV, pH and temperature). The C8000 universal converter is used to receive and transmit data for both standard reusable and single-use systems, increasing the flexibility at any facility.

**See our product information brochure *Single Use Cells Generation 2.0* for further details.**

Available Models					
S.U.C. Types	Conductivity	pH	Optical	Hold-up Volume	Example
SUC21	✓	—	—	20 ml	
SUC23	✓	✓	—	20 ml	
SUC24	—	—	✓	(OPL 1 mm): 9.2 ml (OPL 2.5 mm): 9.7 ml (OPL 10 mm): 12 ml (OPL 20 mm): 15 ml	
SUC25	✓	—	✓	(OPL 1 mm): 22 ml (OPL 2.5 mm): 23 ml (OPL 10 mm): 25 ml (OPL 20 mm): 28 ml	
SUC27	✓	✓	✓	(OPL 1 mm): 22 ml (OPL 2.5 mm): 23 ml (OPL 10 mm): 25 ml (OPL 20 mm): 28 ml	

## 12 | Calibration



optek calibration accessories are specifically designed for nonintrusive calibration and verification of optek systems.

The unique calibration cuvette enables product calibration without need to interfere with the process line. The cuvette allows users to create a correlation of absorption signals to the concentration of product or an equivalent substance, creating an easy link from lab to process.

### UV Sensors

Three series of solid filters are available to ensure confidence in measurements. The UV-L filter series is used to calibrate photometric accuracy and linearity. The UV-B filter series verifies integral blocking and the UV-S filter series tests for long-term stability of the sensor.

### NIR Sensors

A special series of solid filters are available for each wavelength (range) to ensure best measurement performance. The calibration filters are used to calibrate photometric accuracy and linearity.

### NIST-Traceable

All optek UV/VIS filters ship with NIST-traceable (National Institute of Standards and Technology) certification. The optek laboratory is equipped with a high quality, NIST-traceable spectrophotometer to assure quality and quick turnaround time for recertification of filters.



optek Calibration Accessories



High-End Spectrophotometer in optek Calibration Laboratory



## UV Sensors

### Calibration Cuvette

Non-intrusive product calibration, to establish calibration curves (linearization functions) for product or model substance



### Calibration Filters UV-L

Nominal Absorption:  
0.45, 0.9, 1.8 and 2.4 CU\*

Purpose: verify photometric accuracy and linearity

### Calibration Filter UV-B

Nominal Absorption: > 3 CU\*  
Purpose: verify integral blocking

### Calibration Filters UV-S

Nominal Absorption:  
Application specific  
Purpose: test for long-term spectral stability



### Calibration Case

Holds up to 7 calibration filters for safe storage

\*CU = Concentration Units

## NIR-Absorption Sensors

Calibration filters are available with different nominal absorption values for both inline and probe versions of NIR-absorption sensors.

### optek Calibration Concept

Advantages include:

- One filter (set) for multiple sensors ensures identical calibration
- Only the filter needs to be sent back for recertification, while the sensor remains operating

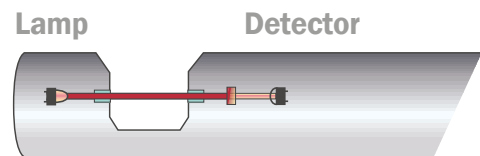




# 14 | Principles of Measurement

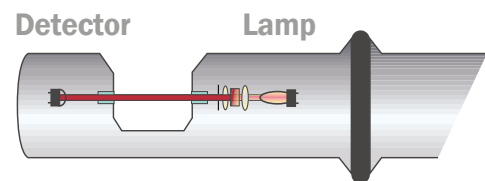
## Probe ASD12 / ASD25

NIR-Absorption,  
single channel concentration measurement



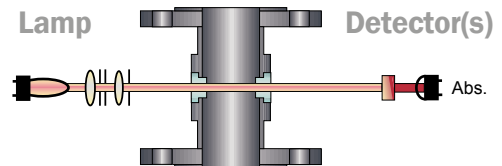
## Probe AS16

VIS- and NIR-Absorption,  
single channel concentration and  
color measurement



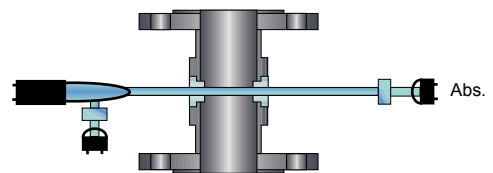
## Sensor AF16

VIS- and NIR-Absorption,  
single channel concentration  
and color measurement



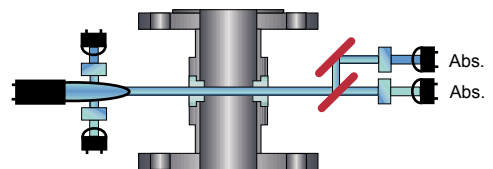
## Sensor AF45

UV-Absorption,  
single channel concentration measurement  
with compensation of lamp intensity



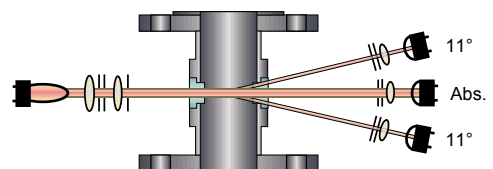
## Sensor AF46

UV-Absorption,  
dual channel concentration measurement  
with compensation of lamp intensity



## Sensor TF16

11° scattered light and NIR-Absorption  
dual channel turbidity measurement



optek offers superior sanitary sensor bodies for inline applications.

## Process Connections:

- Clamp TC L14 AM7
- Flange / Thread DIN 11864
- Tube-end ISO 1127, DIN 11850, BS 4825
- **Hose Barb / Clamp (Single Use Cell)**
- Other aseptic connections on request

## Line Sizes:

- 0.125 - 3.0 inches (DN06 - DN80)
- Others on request

## Materials:

- 1.4435 (316L) stainless steel (BN2)
- 1.4539 (904L) stainless steel
- Gaskets: EPDM (FDA, USP Class VI, 3-A)
- Windows: Sapphire, **Quarz (Single Use Cell)**
- Conductivity: PEEK (FDA, USP Class VI)
- **Single Use Cell:**  
**Polyphenylsulfone (PPSU) (FDA, USP Class VI)**

## Design:

- Minimized hold-up volume
- N5: Ra < 0.4 µm (16 µinch) - electropolished
- Minimal gap, minimal tolerance
- Optimized flow and cleanability
- Wide OPL variations (1 - 200 mm)
- dF < 0.5% with solid block sensor bodies (316L)
- dF < 1.0% with welded sensor bodies (316L)
- Pressure tested according to PED
- Certified materials

optek systems are also available with Explosion proof, PROFIBUS® PA and FOUNDATION™ Fieldbus.





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