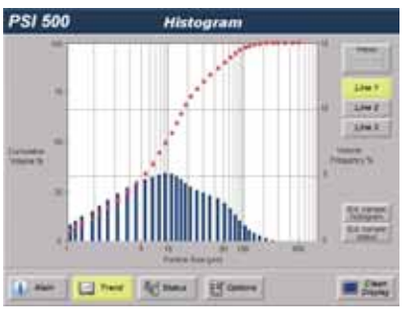
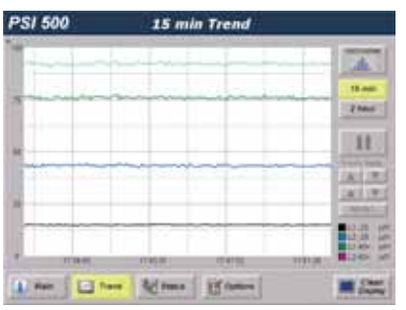
PSI 500™

Advanced slurry particle size analyzer





Your process benefits:

- Maximum throughput
- Maximum recovery
- Minimum reagent costs
- Minimum dewatering costs
- Optimal quality

New view to your process

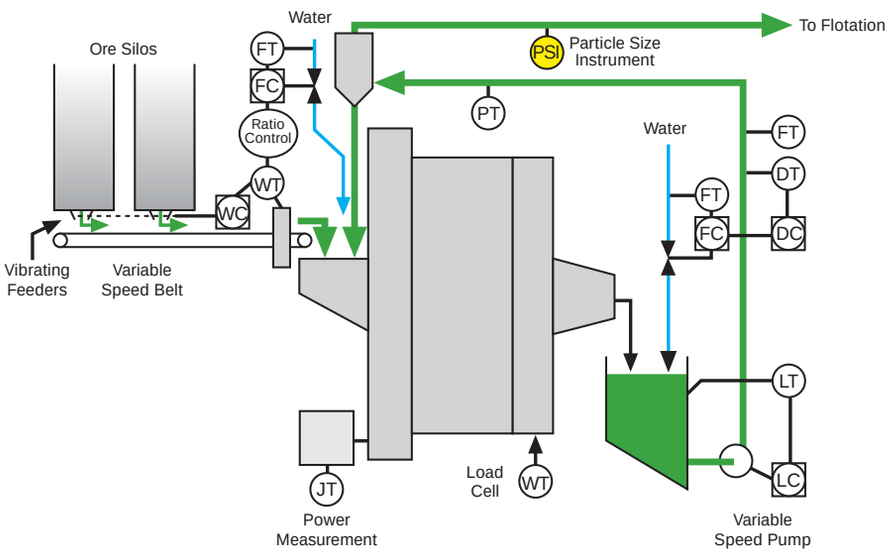
The advanced PSI 500™ technology provides you with new information, which can be used to significantly improve your industrial minerals operations. Particle size monitoring and control improves both throughput and grind in the grinding circuit. Additionally, it improves the downstream process by minimizing reagent consumption, increasing recoveries and making thickening and filtration more effective.

Particle size distribution is an important product quality measurement for industrial minerals operations.

PSI 500™ is used in:

- Grinding circuit products with bimodal distributions
- Control of large thickeners
- Mine backfill monitoring
- Quality control of industrial minerals products

You have to measure it, if you want to manage it

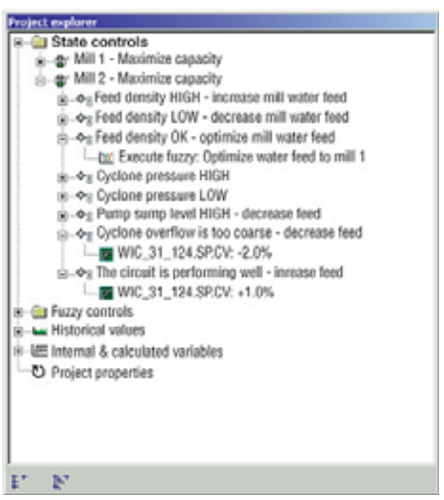


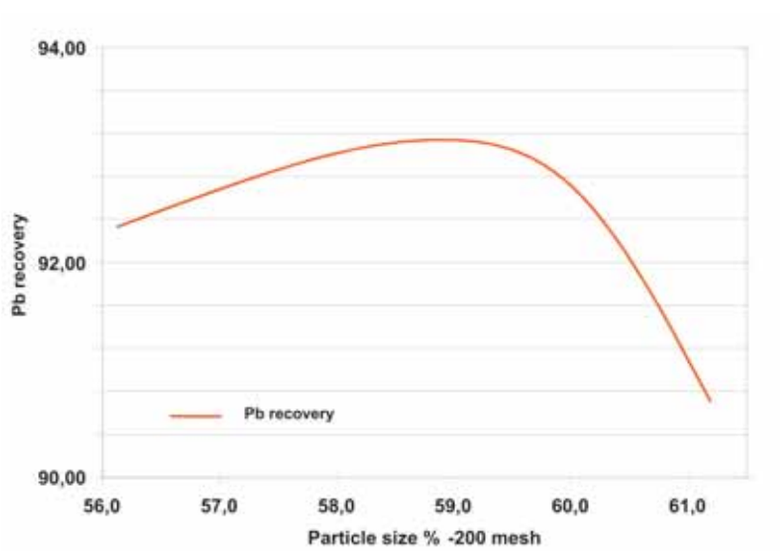
DT	density measurement
DC	density control
FT	flow measurement
FC	flow control
JT	power measurement
LT	level measurement
LC	level control
PT	pressure measurement
WT	weight measurement
WC	weight control

Particle size control

A critical variable for grinding circuit control is the product particle size. Particle size measurement from cyclone or other classifier overflow is the industry practice today. The PSI 500™ Particle Size Instrument provides real-time and accurate particle size distribution measurements. Because the instrument is not sensitive to entrained air in the sample, PSI 500™ can also be used in regrind circuits.

Information from the Particle Size Instrument and other on-line instruments is used for closed loop and expert system control. We have long experience in providing advanced control solutions for grinding circuits. The example on the right illustrates a Proscon ACT expert system program.

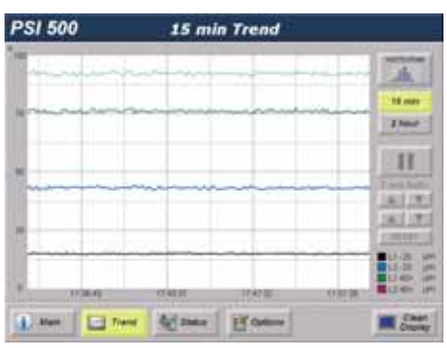




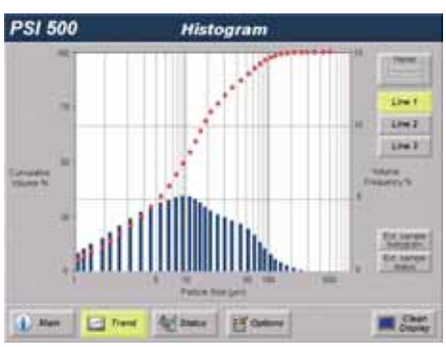
Flotation plant recovery depends on particle size. Particle size measurement and control in the grinding circuit allows process operators to optimize recoveries.

Dependable real-time particle size information provided by the PSI 500™ allows you to manage and control your grinding circuit. Additionally, it guarantees high and stable quality of the end product as well as effective tailings disposal.

The Main-display indicates the operational status of the analyzer. Alarm, warning and information messages are displayed on this screen. Three configurable readings are shown for quick reference.



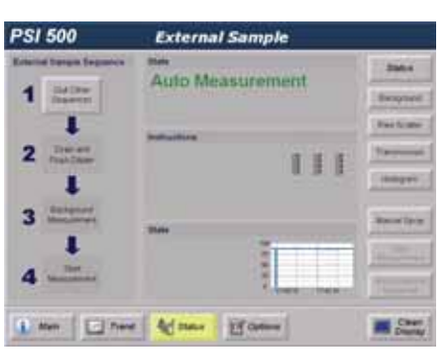
The Trend-display shows four configurable size fraction trends plotted either on a 15-minute or 2-hour time scale.



The Histogram-display shows the current (last measured) particle size distribution. It shows both the volume frequency histogram and the cumulative distribution. There is one display for each sample line.

The Status-display shows the detailed operational state of the analyzer. All active alarm, warning and information messages are displayed on this screen.

The Alarm-display shows alarm and warning message lists over a longer period of time.



The analyzer is able to manually measure introduced samples. The External Sample-display directs the process operator through the measurement sequence.

Primary sampling

A representative 50–170 l/min primary sample is cut from the process flow. PSI 500™ can measure up to three sample streams with optional lines. The analyzer should be located close to the sampling points, so that the sample transport distance is short and continuous gravity flow can be used. Provisions for automatic flushing and cleaning of the sampler and the sample line guarantee high availability of the system.

Secondary sampling

The secondary sampling system cuts a representative 0.01–0.03 l slice every 10–30 seconds from the primary sample flow, by moving the sample line across a stationary cutter. A second cutter in the secondary sampler provides calibration samples or composite samples at the original process solids content for laboratory analysis.

The secondary sample cutting frequency is controlled, enabling keeping sample solids content at the sensor head within acceptable limits. Most of the primary sample is rejected, and typically, it is returned back to the process by gravity.

Diluter unit

The diluter unit mixes water to the secondary sample to allow enough light to pass through it in the sensor head flow cell. Water to sample dilution ratio is typically in the range of 10…100. The top portion of the dilution tank has relatively still flow conditions in order to let entrained air to rise to the surface. Advanced CFD modeling has been used to optimize the diluter design. The tank has about 1 minute residence time. The diluted sample flow at the outlet is 10 l/min.

Optical sensor head

The optical sensor head has a solid-state diode laser, which sends a coherent light beam through the diluted sample. During measurement, the sample flows continuously through a transmission flow cell with parallel hardened windows.

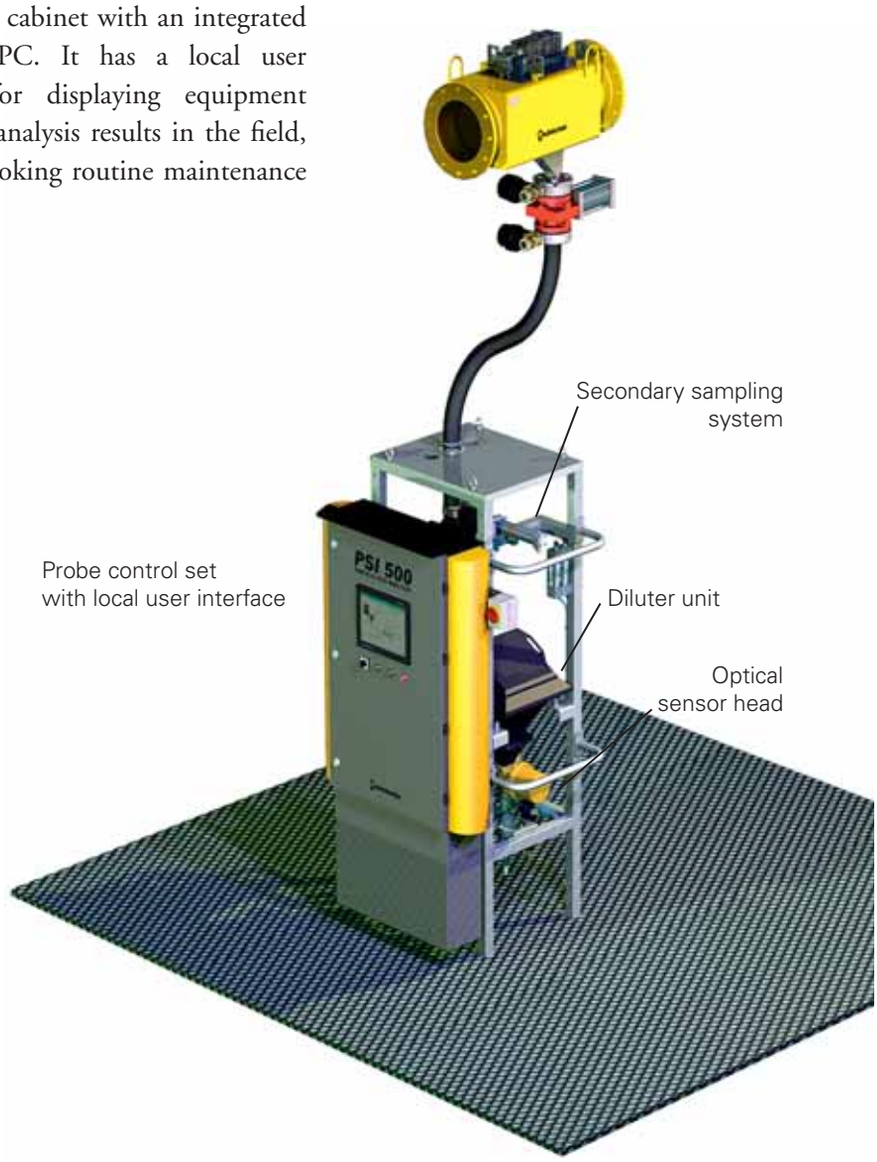
A lens magnifies the beam and a ring detector measures the scattered light distribution on the other side of the flow cell. The flow cell provides a smooth duct channel for the sample flow. Sample flow is turbulent to provide good presentation of large particles.

Probe control set

The analyzer has an electronics and pneumatics cabinet with an integrated industrial PC. It has a local user interface for displaying equipment status and analysis results in the field, and for invoking routine maintenance operations.

The PC hosts software to control and configure the sensor head. A control application synchronizes the measurement with the sampling control sequence and provides an interface for measurement and diagnostic data transfer to the plant automation system. A remote link through a modem line utilizing Web server facilities is available for remote support.

NLA launder primary sampler with mechanical cutter cleaner



Operating principles

Low-angle laser light scattering, or laser diffraction, has been known as a laboratory particle size measurement technique since the 1960's. The size analysis is based on the intensity distribution measurement of coherent light scattered by particles. When the laser beam interacts with particles, their size distribution can be calculated from the scattered light distribution. The scattering pattern is governed by the Mie theory.

Mineral slurry is in most cases so opaque that a thin sample layer with significant dilution would be required in order to pass enough light through it. This requirement can be greatly relieved if a sophisticated calculation technique, so-called multiple scattering, is used for the analysis. With multiple scattering correction, 10–90 % of the laser light passing through the sample is adequate for reliable measurement.

No calibration

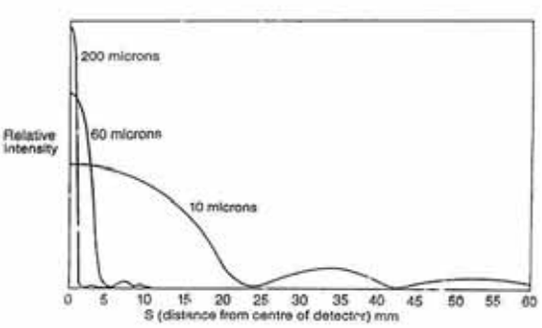
A significant advantage of laser diffraction is that it gives a consistent volumetric particle size analysis result without any external calibration. There is a difference to the particle size analysis measured by other methods, such as sieve analysis. However, the repeatability and precision, that are the most important features in process control applications, are very good over a wide particle size range.

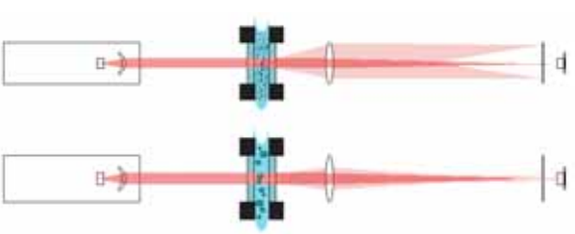
Also the speed, non-contact nature and robustness of the method to ambient conditions make laser diffraction quite suitable for on-line mineral slurry applications. If plant operating practice requires, volumetric distribution measurement results can be correlated to a reference method (sieve, sedigraph etc.) using established calculation models.

The optical measuring head is designed and manufactured by Malvern Instruments in co-operation with Outokumpu Technology. It is based on proven industry standard laser diffraction particle sizing technology, which is routinely used in most laboratories.

Laser scatter

Laser diffraction from single particles creates scatter patterns as shown on the graph to the right. Minerals processing plant samples with a large number of particles and in a range of sizes will produce a smoother scatter pattern as a sum scattering from individual particles. This pattern has information on all the details of particle size distribution in the sample. Size distribution is calculated from the measured scatter pattern by applying the Mie theory for laser scatter and the correction algorithm for multiple scattering.





Small particles diffract laser beam light more than coarse particles. The diffraction pattern is measured by a sensor array and the resulting signals are used to calculate particle size distribution. A beam power detector measures the non-diffracted laser beam for sample dilution control.

Specifications

Primary samples

The standard version of PSI 500™ can be connected to one primary sample line. Paired with the Additional Sample Inlet option, PSI 500™ is capable of measuring up to three primary sample streams.

Primary sample flow rate:
50…170 l/min
Maximum solids content:
sample has to flow
Solids specific gravity of coarse portion: 2–8

Sample handling

Sample dilution:
to 0.5 % (vol.) typical, 10 l/min diluted sample flow
Composite sampling:
undiluted slurry with timed intervals
Sampling control:
primary sampler and sample line cleaning by timed intervals

Analytical

Size range: 1–500 micrometers, size range can be optimized according to application
Calibration: not required
Measurement data output:
20 fractions (%vol. ±x µm or mesh), particle size percentiles (µm at x %), Blaine number (m^2/kg), specific surface area (m^2/cm^3)
Precision: 1–2 % (rel.) for Dv(50) particle size based on a glass bead sample or optical mask measurement
Accuracy: When compared to other particle sizing methods than laser diffraction, differences occur due to different influence of particle shape, particle specific gravity etc. to the analysis. PSI 500™ allows correlation of the measured particle size data to other measurements by independent calibration samples; however, this correlation is application-dependent.
Measurement interval:
- one-line version: 60 seconds
- multi-line versions: typically 3 min/ sample line

Dimensions

PSI 500™ analyzer unit:
- 2100 mm (H) x 1100/1300 mm (W) x 935 mm (D)
- 82" (H) x 43/51" (W) x 37" (D)

Dilution water tank:
- 1630 mm (H) x 1220 mm (W) x 1030 mm (D)
- 64" (H) x 48" (W) x 41" (D)

Weight

PSI 500™ analyzer unit:
200 kg, 440 lbs
Dilution water tank (empty):
165 kg, 360 lbs
Dilution water tank (full):
1365 kg, 2980 lbs

Power

PSI 500™ analyzer unit:
- Single phase AC, 230V +10% at 2A 50/60Hz or 115V ± 10% at 4A 50/60Hz

Dilution water pump:
- Single phase AC, 230V +10% at 4A 50/60Hz or 115V ± 10% at 8A 50/60Hz

A double conversion (AC/DC/AC) UPS 1 kW / 10 min is recommended to secure trouble-free and stable operation.

Water

Quality:
Particle-free (sand-filtered, potable)
Water consumption:
10 l/min (2.6 GPM) average
Water temperature: max. 40°C
Inlet: 1" hose coupling

Instrument air

Oil-free instrument air:
5…10 bar (75…145 psi)
Air consumption:
7 Nl/min (1.8 GPM) average
Inlet: 1/2" hose coupling

Data connections

DCS connection: Ethernet OPC (PSI 500™ is a server), Modbus TCP (PSI 500™ is a server), Modbus RTU (PSI 500™ is a master)
Remote diagnostics connection:
Ethernet or dial-up modem line
Remote display: Web server

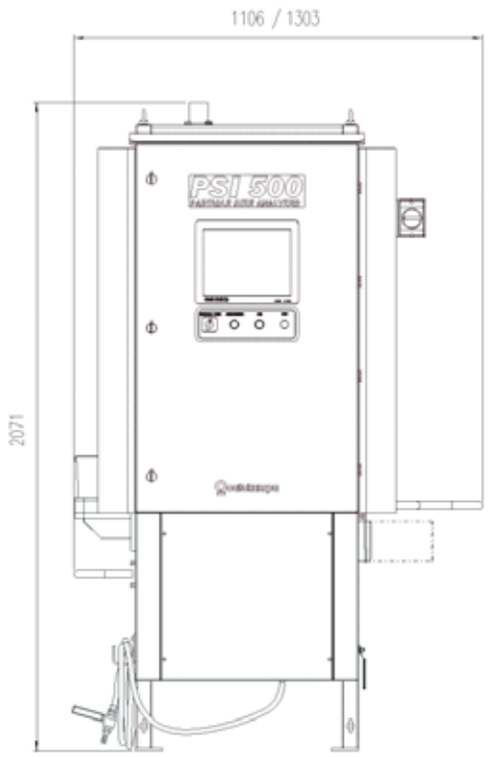
Environment

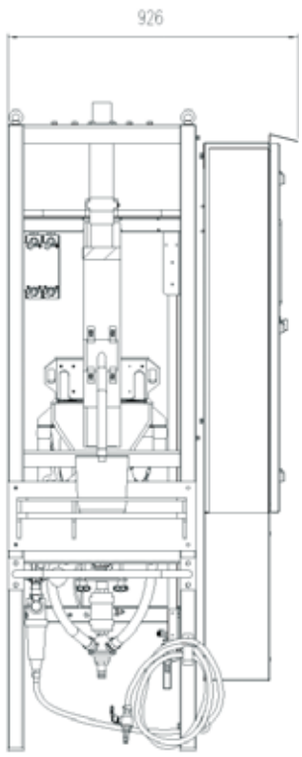
Ambient temperature: 5–45°C (no direct sunlight), cooler option for temperatures above 35°C
Installation altitude: 0 to 5000 m (16000 ft) above sea level
Sample temperature: 5–50°C
Corrosion: AISI 316 when in contact with sample, AISI 304 elsewhere
Moisture: up to condensing conditions
EMC: heavy industrial environment, EN 50082-2 & EN 50081-2
Shock: 15 G equivalent / 11 ms
Vibrations: 1 G / 5–150 Hz

ISO 9001 quality assurance

Outokumpu Technology is ISO 9001 accredited and has a rigorous quality management policy to ensure that the quality expectations of customers are met. The analyzer has CE certification.

Main dimensions





Specifications are subject to change without notice.
Please see the PSI 500™ data sheet for details.

Other on-line particle size analysis methods

PSI 200™ Particle Size Instrument is an on-stream slurry particle size analyzer for minerals processing plants optimized for D80 measurement.

The instrument takes a representative 70–170 liters/minute sample from the process streaam using a primary sampler. Its measurement principle is based on direct measurement of particle size using a high-precision automatic caliper. The measured size range is from 20 to 600 microns. Accurate particle size, passing and retained readings are calculated twice per second based on 60 seconds of measurement data.

The result is displayed locally on a large display and sent out as a 4–20 mA instrument signal or as serial data to the plant´s DCS system. The measured particle size can be used for on-line process control.

PSI 200™ has become the industry standard for slurry particle size measurement during the past 10 years. Ultrasonic attenuation has also been used for on-line measurement of particle size. This method is indirect and requires a sample air removal system.

3030EN. Libris, Helsinki, Finland. April 2004.

Outokumpu is a dynamic metals and technology group. Focusing on our core competences, that is, extensive knowledge of metals and metals processing, we aim to be leaders in all of our key businesses: stainless steel, copper and technology. Customers in a wide range of industries use our metals, metal products, technology and services worldwide.

OUTOKUMPU

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