



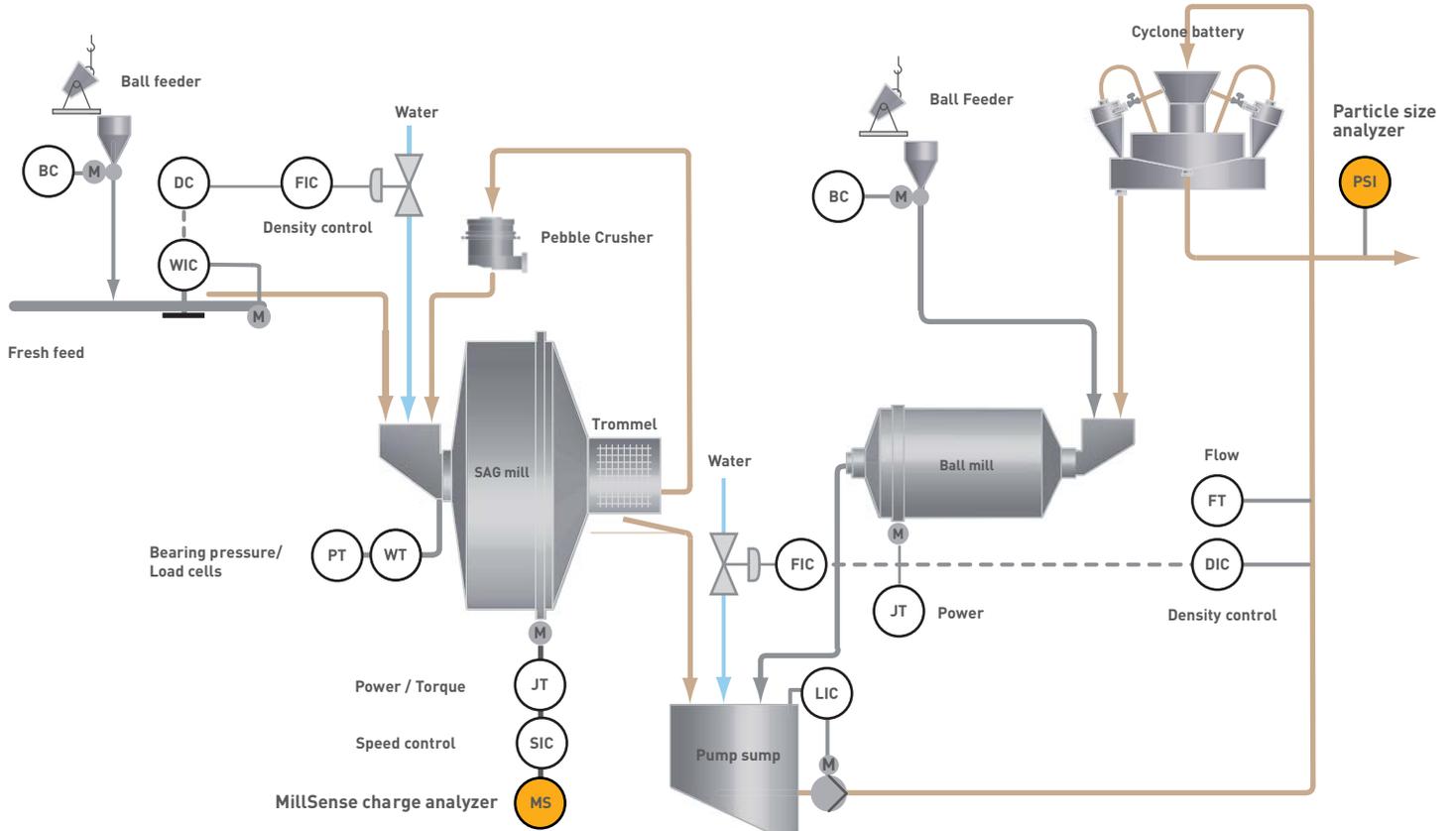
PSI® 300

## On-line slurry particle size analyzer

Particle size monitoring and control increases average throughput and reduces particle size variability in grinding products. This improves the downstream process by minimizing reagent consumption, maximizing recoveries and improving de-watering efficiency.

The PSI 300 Particle Size Analyzer is an on-line analyzer system for mineral slurries. It automatically takes samples from one to three process streams and measures P40 to P90 particle size in the range of 25–1000  $\mu\text{m}$  (500 to 15 mesh). Density and pH of the sample can be measured as an option.

**Outotec**



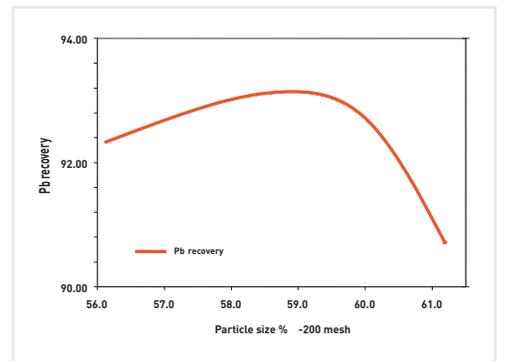
# To manage it, you have to measure it

## Particle size monitoring and control

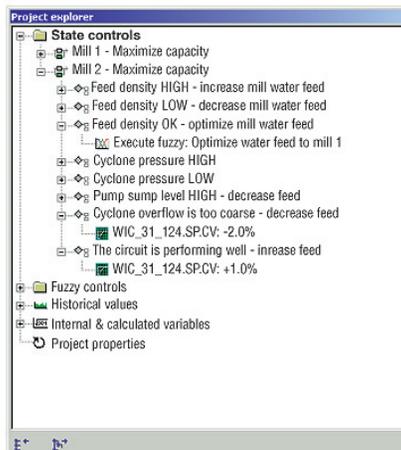
The most important targets for grinding circuit control are the feed rate and product particle size. Particle size measurement from cyclone or other classifier overflow is the industry practice today. The PSI 300 Particle Size Analyzer can provide particle size measurements in real-time and with great accuracy.

The PSI 300 analyzer can also be used in regrind circuits since it is not sensitive to entrained air in the sample.

Particle size and other on-line analyzers measurements are used for monitoring and expert system control. Particle size measurement and control in the grinding circuit allow process operators to react immediately to grinding problems and to optimize plant availability and recoveries.



Particle size has an effect on the recovery in flotation circuits.

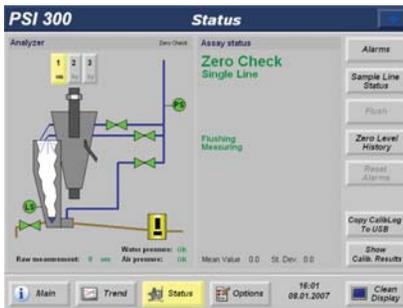


As a major supplier of grinding mills and automation for the mineral processing industry, Outotec has a broad experience in practical advanced control solutions for grinding circuits. The ACT expert system program (left) is one example of an Outotec solution used widely throughout the industry.



# See what is going on

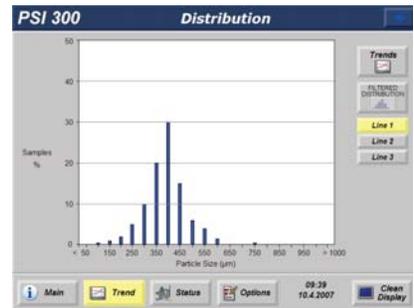
Dependable real-time particle size information provided by the PSI 300 allows you to manage and control your grinding circuit.



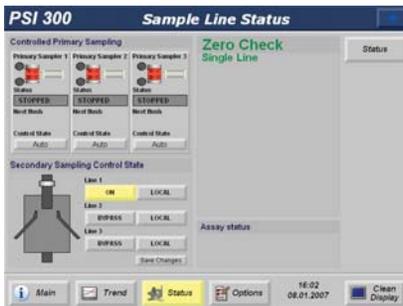
The main display indicates the operational status of the analyzer. Alarm, warning and information messages are displayed.



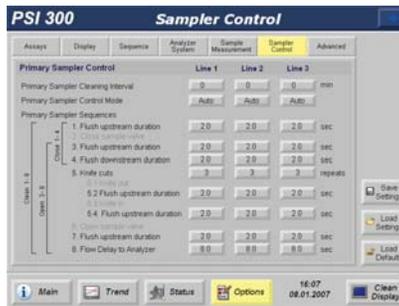
Each of the three trend displays shows four configurable size fraction trends plotted either on a 2-hour or 8-hour time scale.



The histogram display shows the current (last measured) distribution of actual measurements.



The sample line status display shows the detailed operational state of the primary and secondary sampling.



Process operators and metallurgists can configure the timing of sampling using this interactive display.



The alarm display shows alarm and warning message lists for quick troubleshooting and preventive maintenance.

# PSI<sup>®</sup> 300 analyzer

## Primary sampling

A representative stable primary sample flow is essential for dependable particle size measurement. PSI 300 can handle one to three sample inlets, each with a recommended 70–170 l/min flow. The ideal location for PSI 300 is just below the primary sampler for the shortest distance sample gravity flow. The PSI 300 has integrated, automatic controls for the primary samplers, with optional remote controlled water and slurry valves and sample cutter cleaner. When utilized, these options guarantee high sample availability.

## Secondary sampling

Primary samples are directed to a reject outlet when they are not measured. A moving hose sampler after each primary sample inlet cuts a secondary sample for the actual particle size measurement from one sample line at a time. A self-cleaning trash screen and a small level controlled tank are used to remove trash, oversized particles and air bubbles from the sample. The primary sample flow is reduced to a stable 10–20 l/min flow, which is fed internally to the PSI 300 sensors by gravity. An automatic water spray – flush – dump valve system kills froth, prevents sanding and reduces scaling to a minimum.

The secondary sampler moving hose passes across a static cutter at programmed intervals to provide calibration samples or composite samples at the original (process) solids content for laboratory analysis.

Samples are typically returned to a nearby process pump sump by gravity.

## Sensor head

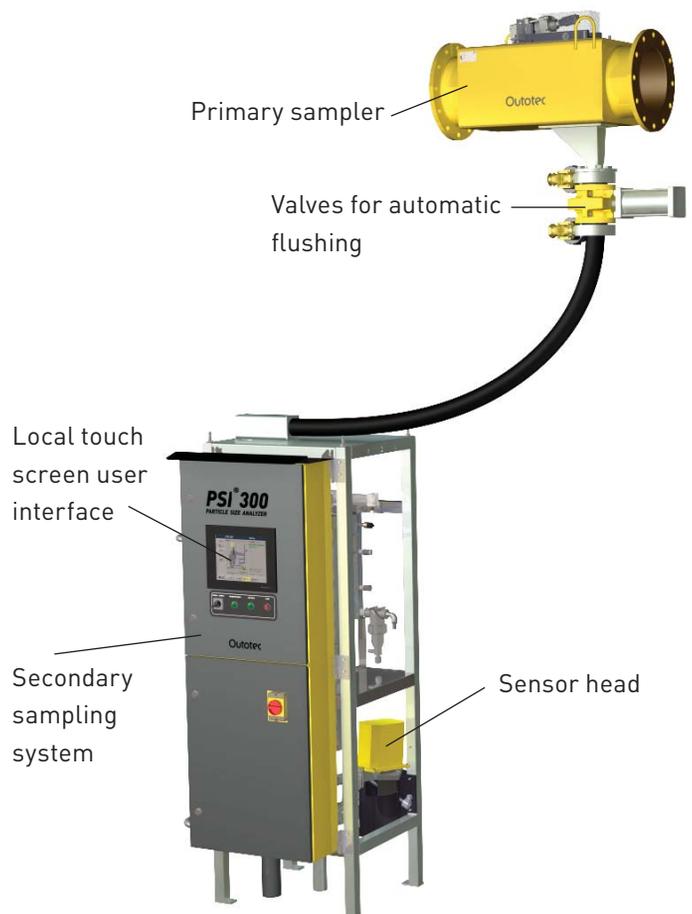
The PSI 300 sensor head is based on direct size measurement of a representative sample of particles. The precision size caliper measurement data is converted to size fraction readings for each measured stream. Each of these corresponds to a user definable particle size screen fraction, such as percent passing 74 microns. This information is displayed on the analyzer's touch screen and can be sent to the plant process control system by several alternative communications protocols.

Primary measurement results are calibrated against a reference method (sieve, for example). Calibration is robust, since the direct size measurement principle is not sensitive to changes in slurry viscosity, temperature and other properties. Periodic automatic zero check compensates for any drift and monitors the sensor operation.

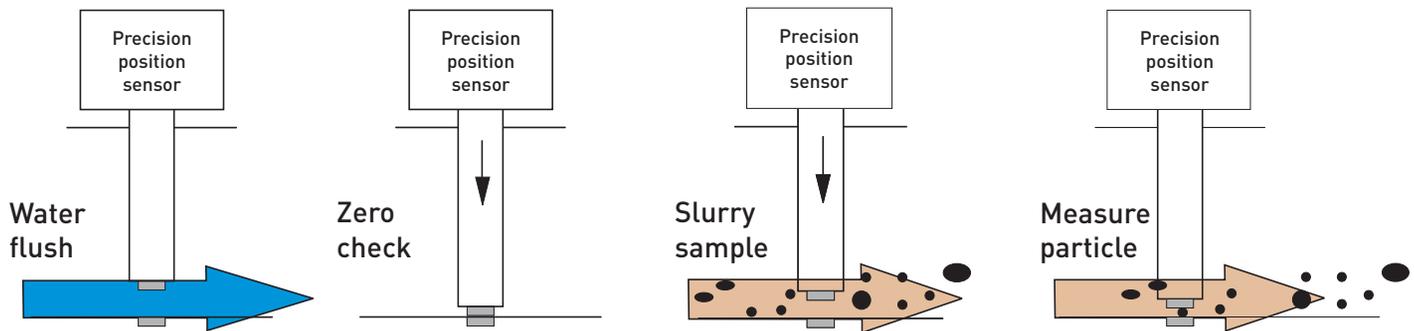
## Sampling and analysis control

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

The PC hosts control and configuration software for the analyzer. 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. Analyzer results and status can also be seen through networked PCs, for example, in the control room.



# Operating principle

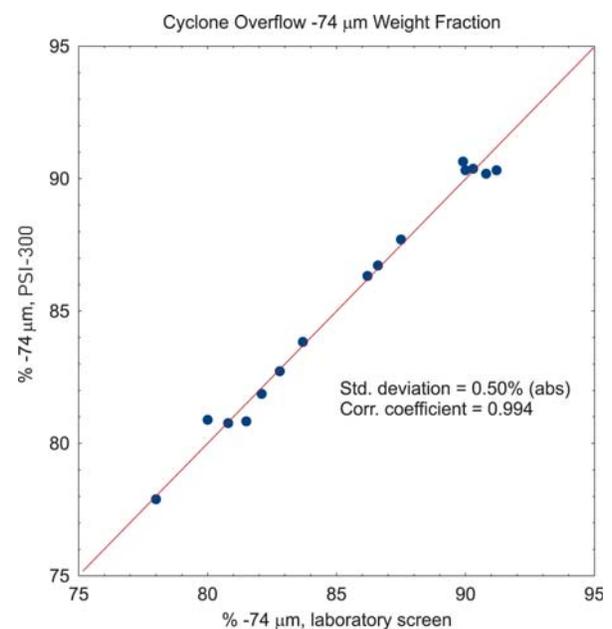


The PSI® 300 analyzer actually measures a large number of particles from a representative sample. The analyzer uses a high-precision ceramic-tipped sensor to measure the size of randomly selected particles. The sensor sends the information to an integrated panel PC, which converts it to calibrated percent readings passing the selected mesh or micron sizes. The result is updated once per second based on the 120 measurements performed during the past 60 seconds. A zero check once per shift verifies operation and compensates for drift.

## Calibration

The PSI 300 is calibrated by measuring a series of samples and correlating the sensor signal readings with respective laboratory screen analyses. During the calibration procedure, sensor readings are saved and the measured sample is diverted by the calibration sampler into a sample bucket.

A quick calibration requires only a couple of samples. A range of approximately 20 samples is required to get the most accurate calibration equation. Due to the direct size measurement principle and automatic zero check, calibration stays stable over a long period of time.



PSI® 300 readings are typically within 1–2% absolute error when compared with accurate laboratory screening results.

## New features:

- n Touch screen graphic operator interface
- n Improved secondary sampling system
- n Improved non-nuclear density measurement
- n pH measurement option

# Specifications

## Sampling

PSI 300 is available with 1, 2 or 3 sample inlets.

**Primary sample flow rate:**  
Recommended 70...170 l/min,  
50–300 l/min max range

**Maximum solids content:**

Sample has to flow

**Composite sampling:**

At user specified intervals

**Calibration sampling:**

By manual request with  
measurement data recording

## Analytical

**Size range:** 25–1000 micrometers,  
size range can be optimized  
according to application

**Measurement data output:** Up to  
40 items, particle size fractions  
(%  $\pm$  x  $\mu$ m or mesh), particle size  
percentiles ( $\mu$ m at x %), primary  
sample flow rate, optional density,  
optional pH

**Precision:** Typically 1–2% (abs.)  
for P80 particle size fraction

**Accuracy:** Results by other particle  
sizing methods can be different  
due to the influence of particle  
shape, particle specific gravity and  
variance between sets of screens.  
The system allows correlation of  
the measured particle size data to  
other measurements by calibration  
samples.

**Measurement interval:** Size  
measurement is done 2 times a  
second, one sample line analysis is  
updated typically each 70 seconds,  
multi-line update typically 90  
seconds/sample line.

## Options

**Primary sampler control option**

Remote control for water and  
sample valves allows automatic  
cleaning of the primary sampler at  
user specified intervals.

## Density meter option



Result is given as density (g/l)  
or percent solids (%) for each  
sample stream. Absolute one-  
sigma accuracy is typically 5 g/l for  
density and 1 unit % for solids by  
weight.

## pH meter option



The pH of the slurry secondary  
sample stream is measured by  
optional pH sensor.

Range 0–14 pH, 0–80 °C.

## Saline-water option

If saline flush water is used, the  
PSI 300 can be supplied with acid  
proof valves.

## DCS connection alternatives

- Modbus RTU slave as standard  
(master as a special option)
- Optional Modbus TCP slave
- Optional Profi bus DP (200 bytes)  
slave
- Optional Ethernet OPC server

## Service options

Service contracts are available  
worldwide. Remote connections  
can be used to display the analyzer  
status, analysis results and  
diagnostics. A VPN connection or  
dial up modem line is required.

## Dimensions

**PSI 300 analyzer frame:**

2100 mm (H) x 920 mm (W) x 930  
mm (D) (83" (H) x 36" (W) x 37" (D))

Shipping (without primary  
samplers)

**PSI 300 analyzer net:** 250 kg (550 lbs)

**In package:** about 350 kg (770 lbs)

**Shipping volume:** about 4 m<sup>3</sup>

**Storage temperature:** -10 – +60 °C

## Power supply

**PSI 300 analyzer unit:** Single phase  
AC, 2 A/230 V  $\pm$ 10% at 50/60 Hz or  
4 A/115 V  $\pm$  10% at 50/60 Hz

A double conversion (AC/DC/AC)  
UPS 0.5 kW/10 min is recommended  
to secure trouble-free and stable  
operation.

## Water

**Specification:** Sand-filtered raw  
water, 4–6 bar (58–87 psi)

**Consumption:** Typical average  
less than 2 l/min (0.6 gal/min),  
momentarily 30 l/min (8.5 gal/min)  
during flush and zero check.

## Instrument air

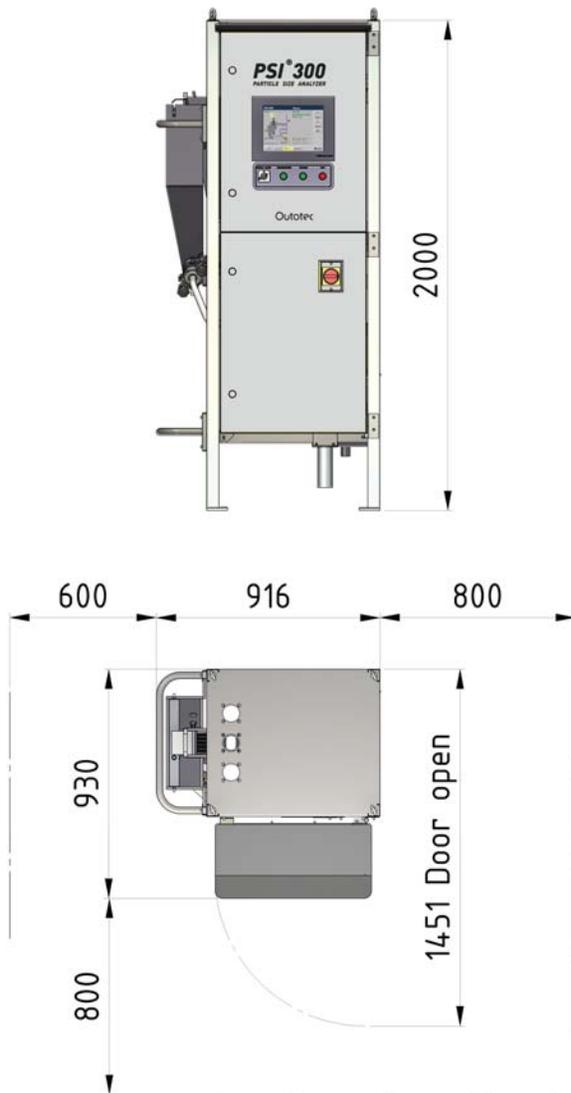
**Air specification:** Oil-free  
instrument air 5...10 bar (75...145 psi)

**Air consumption:**

7 NL/min (0.25 SCFM) average

## Materials

AISI 316, HDPE, rubber and silicone  
when in contact with sample, AISI  
304 elsewhere, cabinet AISI 304  
with RAL 1023 powder polyester  
paint 60–80  $\mu$ m.



### Environment

**Ambient temperature:**

5–45 °C (41–110 °F), no direct sunlight

**Installation altitude:**

0 to 5000 m (16000 ft) above sea level

**Sample temperature:**

5–50 °C (with secondary sampler stainless steel tank option up to +80 °C)

**Humidity:**

30–85% relative humidity, no condensation

**EMC:**

Heavy industrial environment,  
EN 50082-2 & EN 50081-2

**Shock:**

15 G equivalent/11 ms IEC68-2-27

**Vibration:**

1 G/5–150 Hz IEC68-2-6

### Standards

Equipment conforms with the European Union machine directive, low voltage directive and EMC directive for heavy industrial environment

– Protection code for environment:

IP56 (corresponds to NEMA 4X)

PSI® is a registered trademark and MillSense™ is a trademark of Outotec Oyj.

Specifications are subject to change without notice. Please see the PSI® 300 data sheet for details.

### Other on-line slurry particle size analysis methods

The original PSI® 200 model, now updated to PSI® 300, became the industry standard for on-line slurry particle size measurement.

The PSI® 500 Particle Size Analyzer is an on-stream slurry particle size analyzer for minerals processing plants particularly for wide 1–500 micron size distribution and Blaine measurement. The analyzer measures 50–170 liters/minute samples from 1 to 3 primary samplers. Its measurement principle is based on the scatter of a laser beam by particles in a diluted representative sample of slurry. Accurate particle

size, passing and retained readings are updated every 3 minutes per measured sample stream. The result is displayed locally on a large display and sent out as serial data or 4–20 mA instrument signals to the plants DCS system. The measured particle size can be used for on-line process control.

Ultrasonic attenuation has also been used for on-line measurement of particle size. This method is indirect and requires a maintenance intensive sample air removal system for mineral processing plant samples.



*Outotec is a worldwide technology leader in minerals and metals processing, providing innovative and environmentally sound solutions for a wide variety of customers in minerals processing, iron and steel, aluminum and non-ferrous metals industries. Outotec Oyj is listed on the Nasdaq OMX Helsinki.*

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