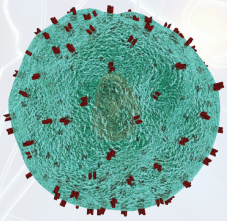
Elemental Scientific

microFAST Single Cell

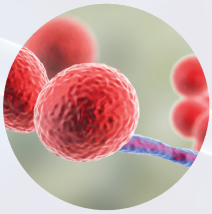
Complete Solution for Single Cell ICPMS Applications

Automated sample introduction systems for ICPMS

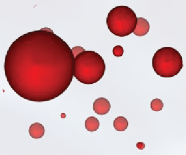
Biological Size Scale



HIV



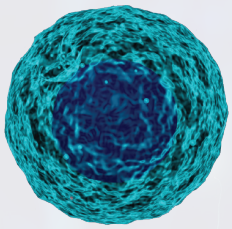
Fungal Cells



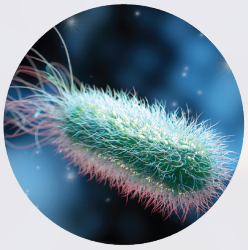
Red Blood Cells

10 nm | 150 nm | 1 µm | 5 µm | 10 µm

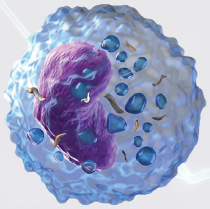
Exosomes



Bacteria



Small Lymphocytes



Biological Size Scale

Large Lymphocytes

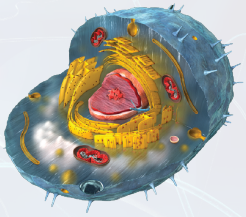
15 µm

20 µm

100 µm

Yeast Cells

Eukaryotic Cells



Single Cell ICPMS

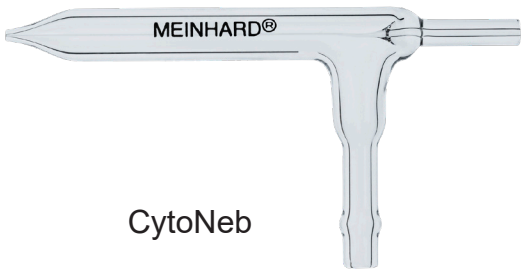
The ability to introduce single cells into an ICPMS and measure the elemental content in each cell, or tagged to each cell, accurately takes a dedicated, well-designed sample introduction system. Having this ability allows for investigators to better understand how much of a specific nanoparticle, metallodrug, or metal-based compound enters the cell. These cells or nanoparticles will vary in size from a few nm's up to a few 100 µm's. The typical cell types of interest will vary and with that the stability of the cell-line also varies, such that a gentle, controlled nebulization must be employed in order to not disrupt or lyse the cell.

Single Cell ICPMS Requirements

- Flexible sample volumes – µL to mL of sample
- Ensure cells stay intact, no cell lysing
- Low pressure sample introduction
- High transport efficiency

Elemental Scientific has developed a complete sample introduction system designed specifically for single cell and nanoparticle applications. This system consists of:

- **micro*FAST* Single Cell Autosampler**
- **CytoNeb** – single cell nebulizer
- **CytoSpray** – single cell spray chamber



CytoNeb

CytoSpray

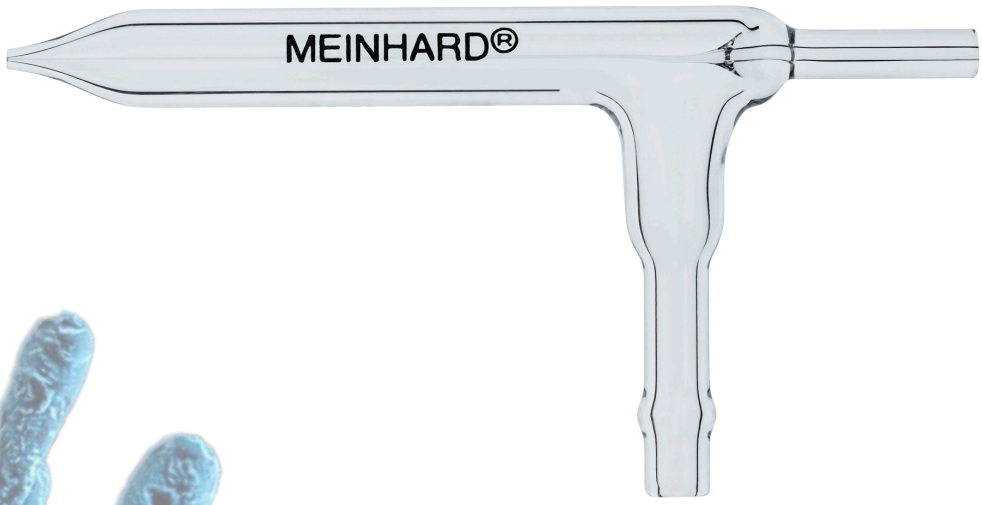
micro*FAST* Single Cell

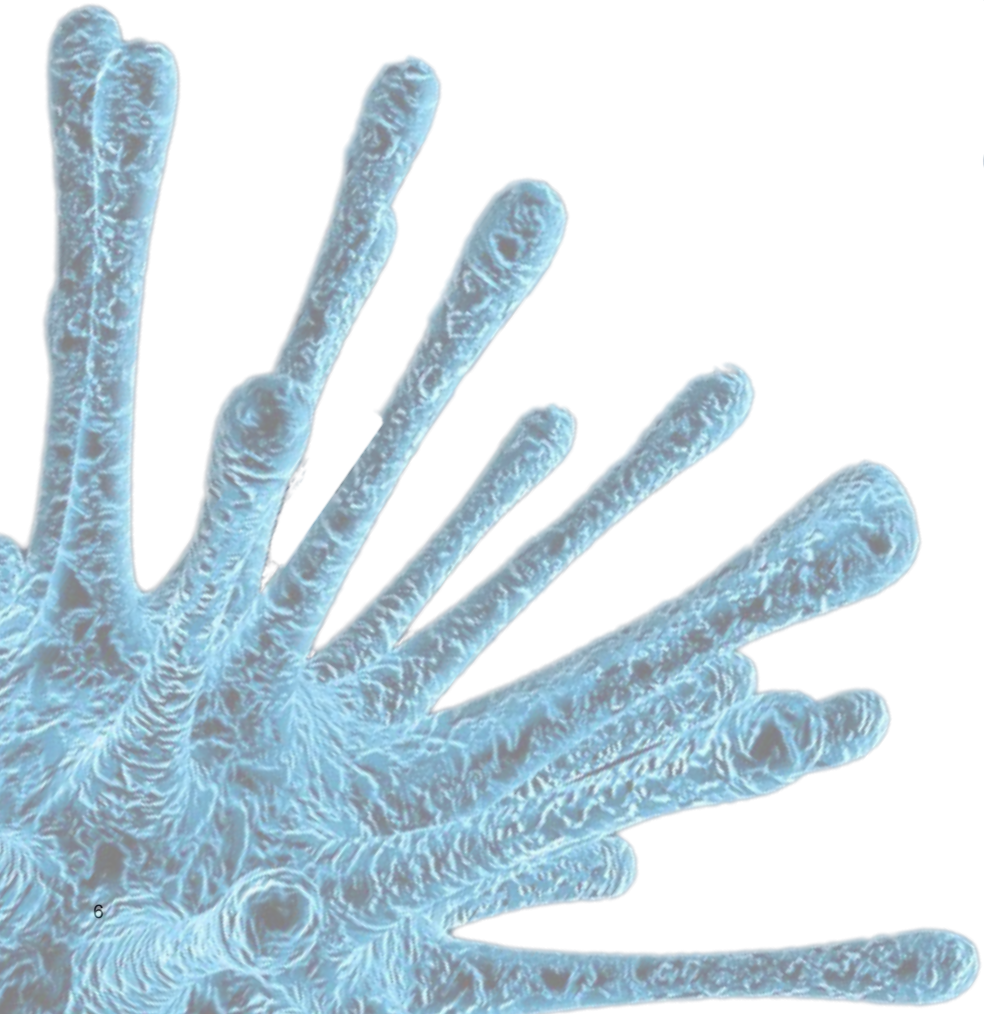
micro*FAST* Single Cell Automated
Sample Introduction System

CytoNeb and CytoSpray

CytoNeb

- Meinhard high efficiency nebulizer
- Designed to efficiently nebulize single cells without cell rupturing
- Low internal volume
- Low backpressure (1-50 µL/min = <50 psi)
- Low dead volume
- Patented inert PFA quick connects for nebulizer gas and samples lines

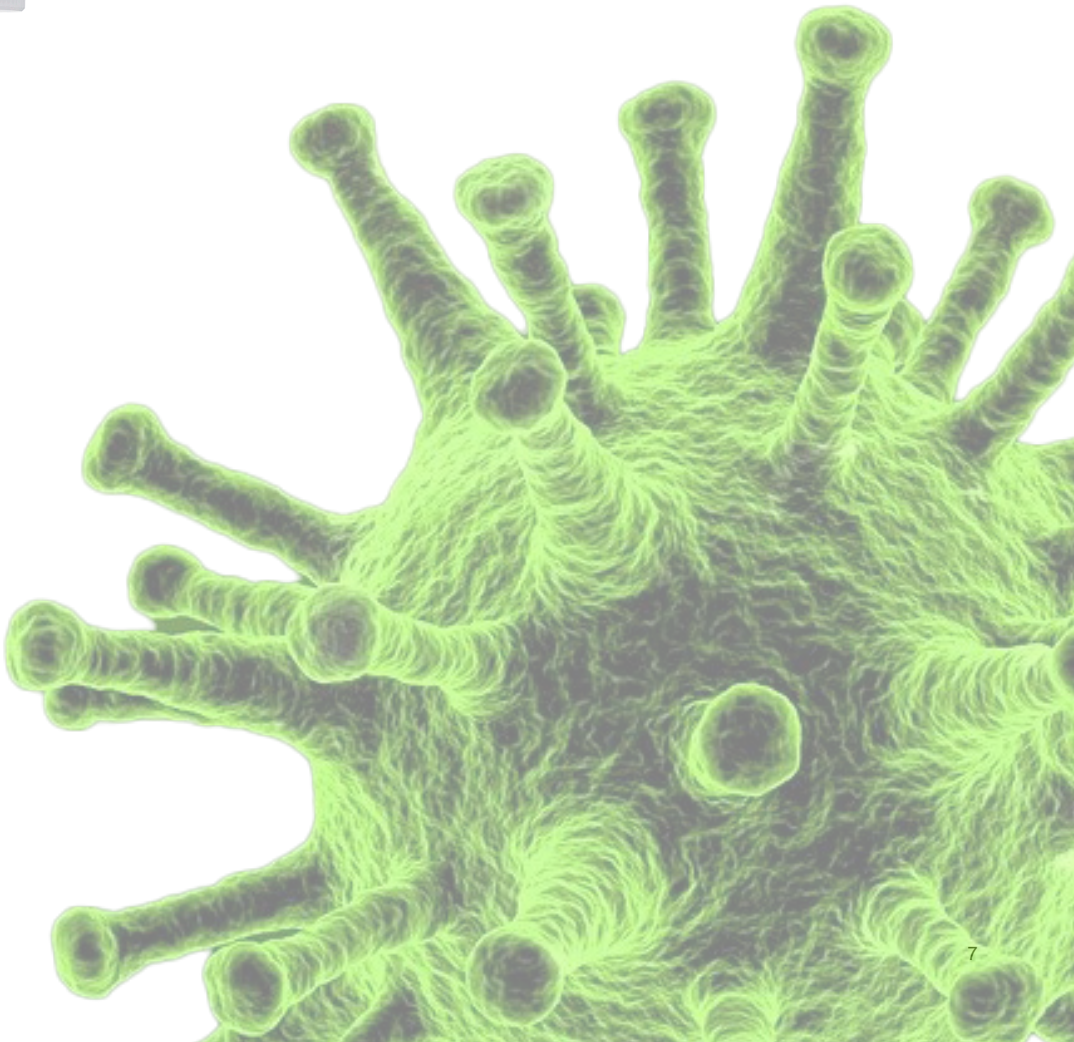




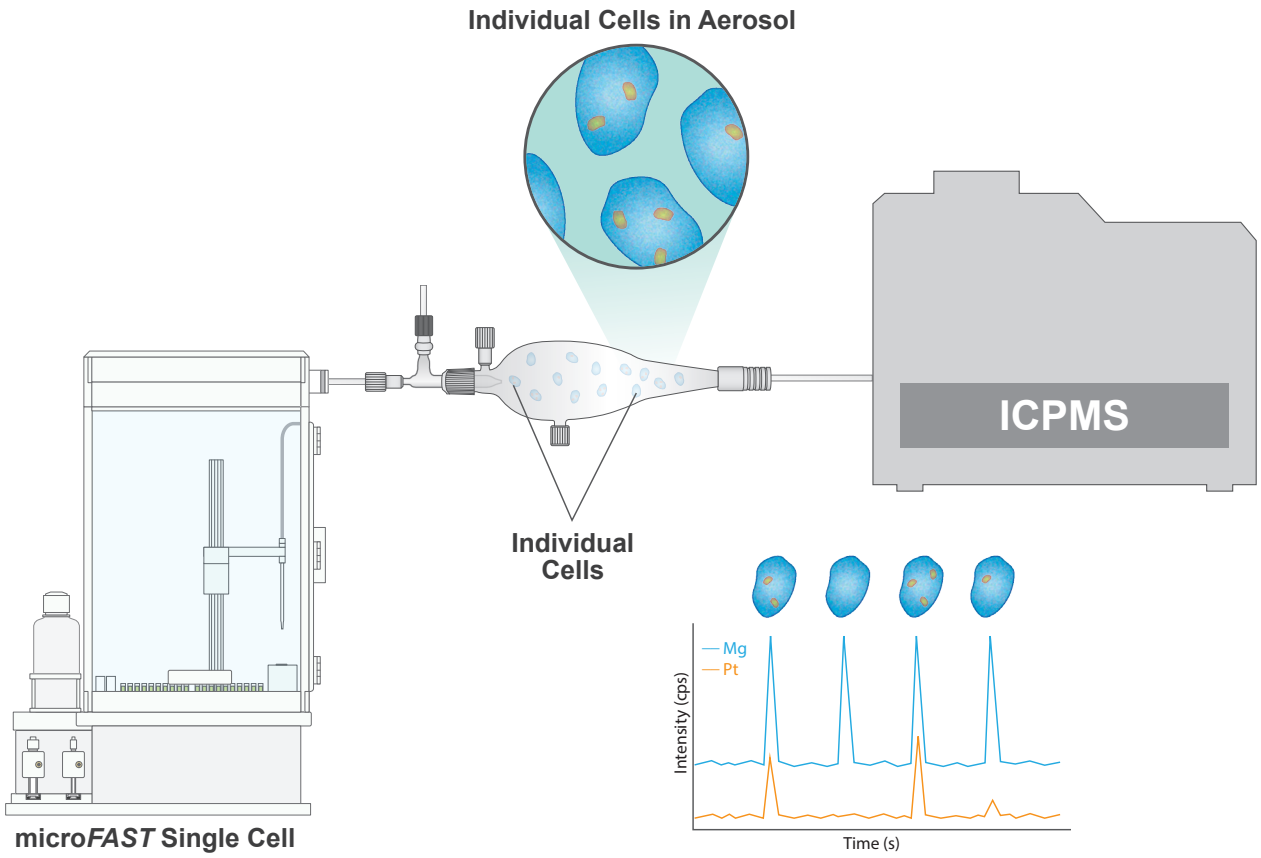
CytoNeb and CytoSpray

CytoSpray

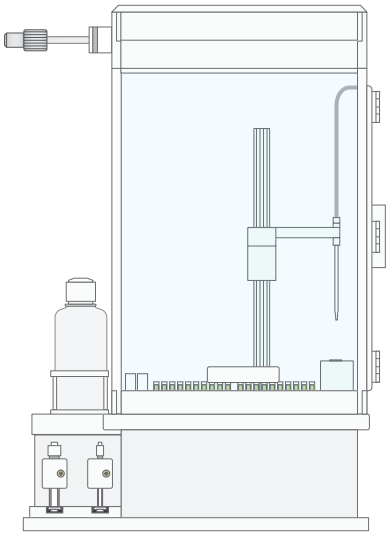
- Spray chamber designed specifically for single cell and nanoparticle applications
- High-transport efficiency
- Separate make-up gas for better transport efficiency
- Includes one-piece ICPMS torch for simple and direct connection to the CytoSpray



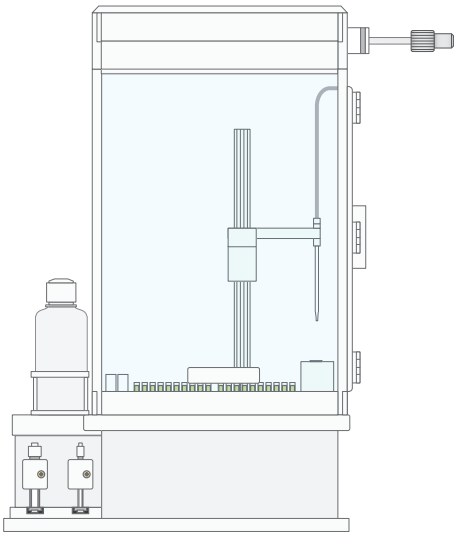
microFAST Single Cell System



microFAST Single Cell system comes in two different orientations:

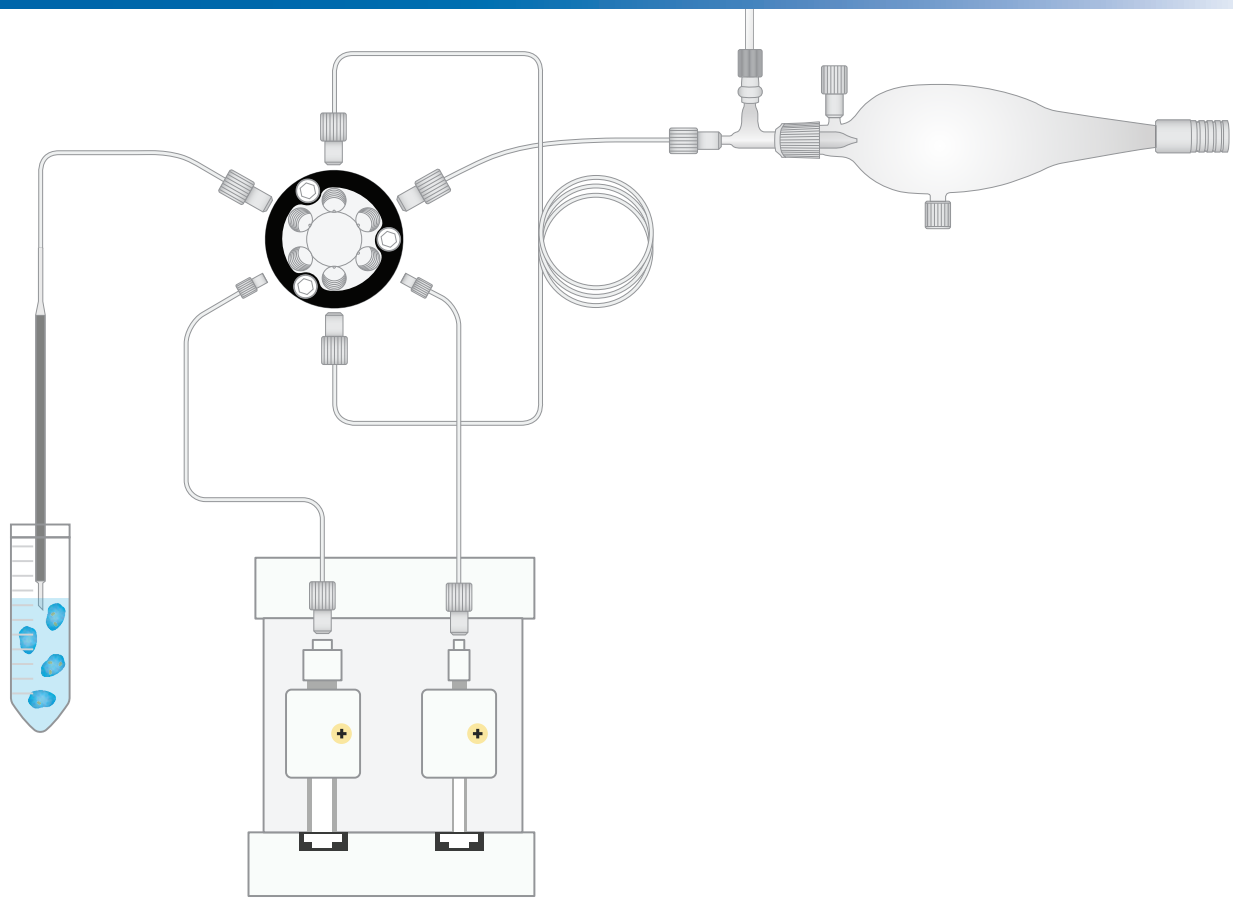


Left-handed



Right-handed

micro*FAST* Single Cell System

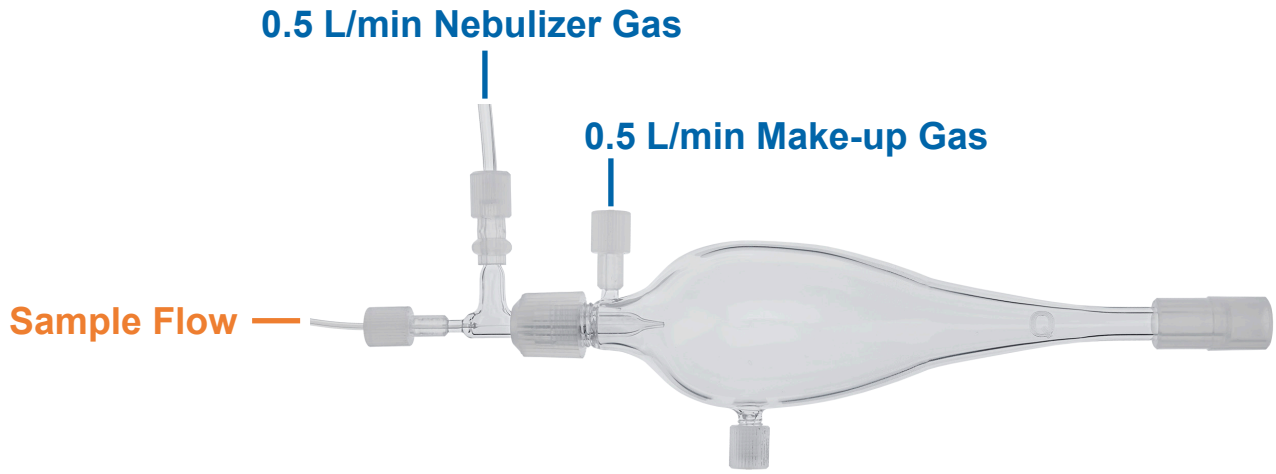


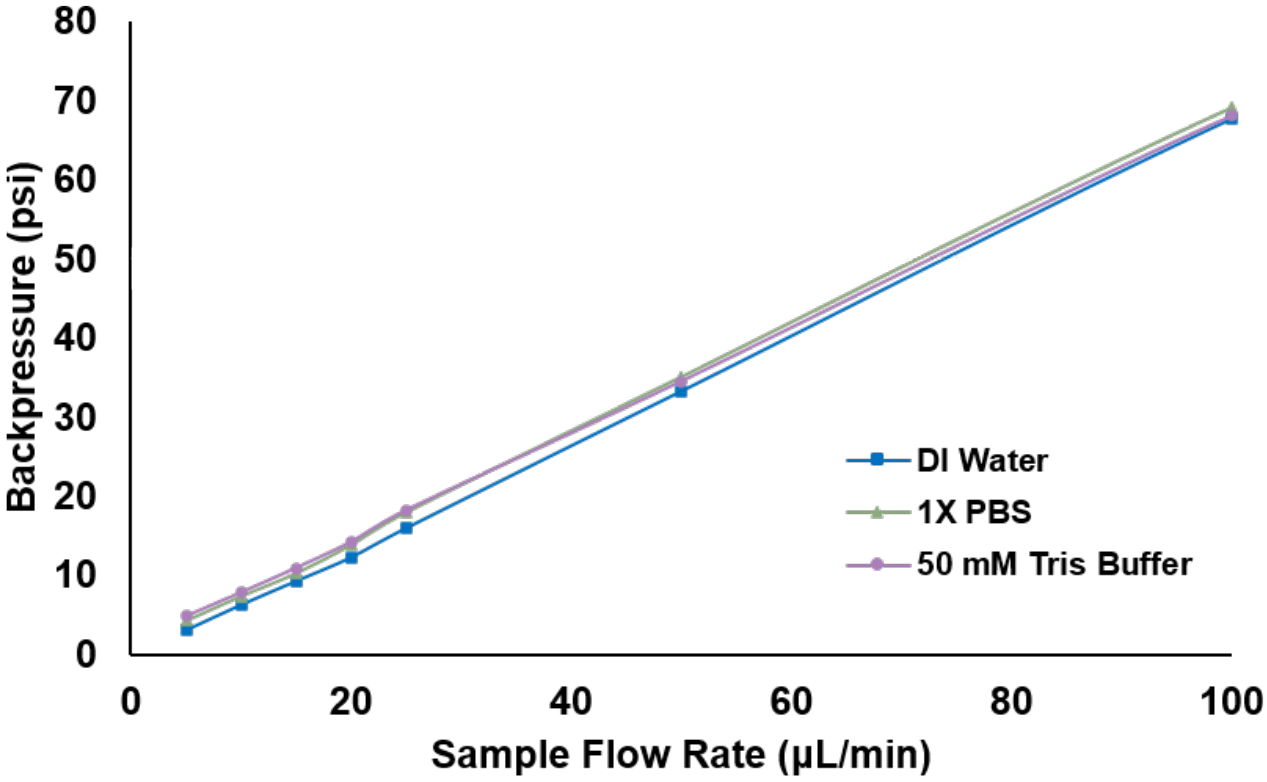
micro*FAST* Single Cell flow path with syringe carrier and sample loading

The micro*FAST* Single Cell system has been built for performance by optimizing the inner diameter (ID) and line lengths to ensure a quick sample transfer from vial to ICP torch.

- Fast sample-to-sample times. For example, at 20 µL/min flow rate:
  - <3 min, when utilizing a 30 s ICPMS measurement time
  - <4 min, when utilizing a 100 s ICPMS measurement time
- High-flow sample loop washout
- Simple conversion for total metal analysis using *FAST* system
  - Vacuum or syringe sample loading
  - Micro or large sample volume capabilities

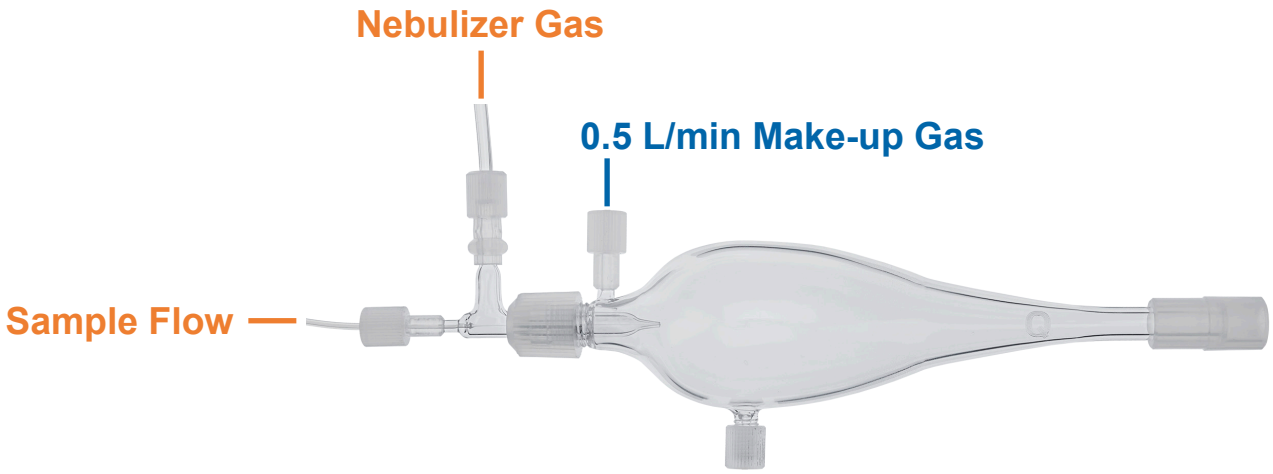
Single Cell Introduction Kit

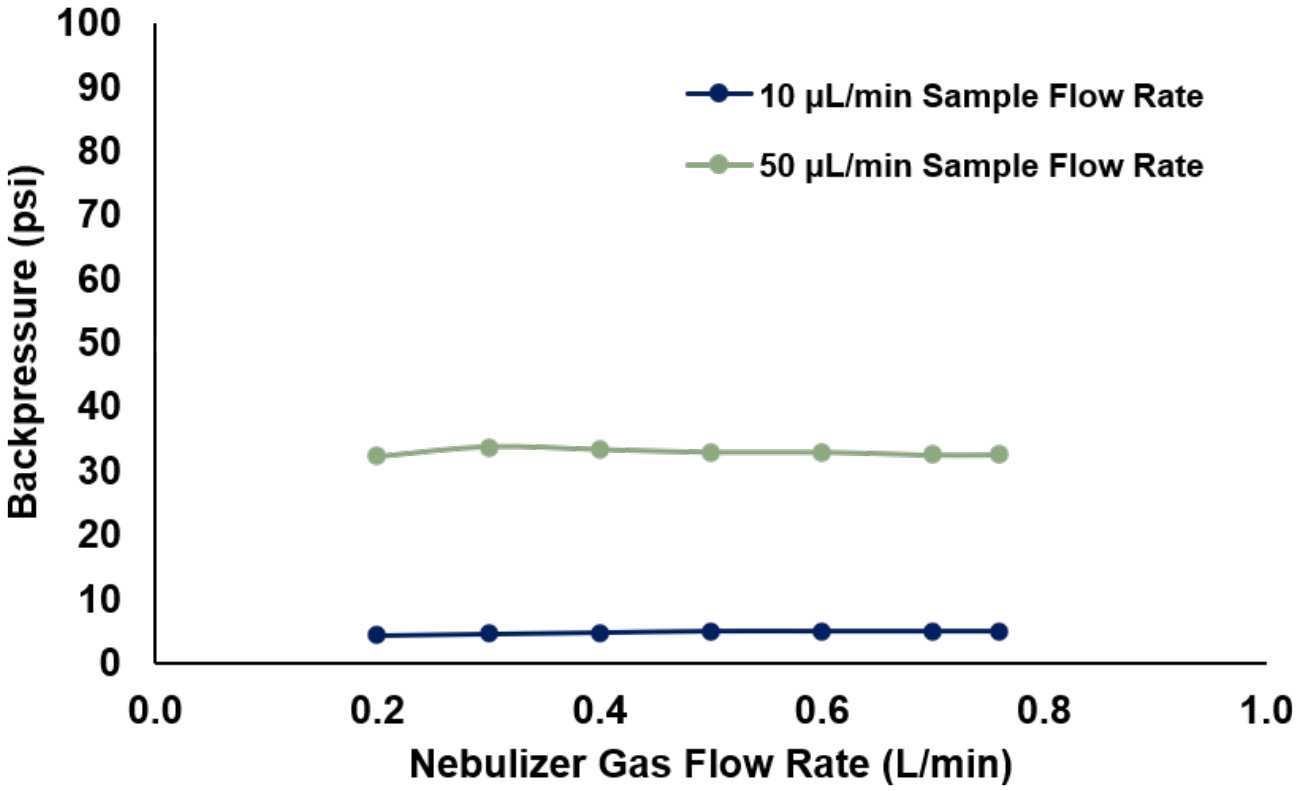




Backpressure was recorded for each sample flow rate using DI water, 1X PBS, or 50 mM Tris buffer as the carrier solution. Larger ID tubing can be substituted to achieve lower backpressures.

Single Cell Introduction Kit



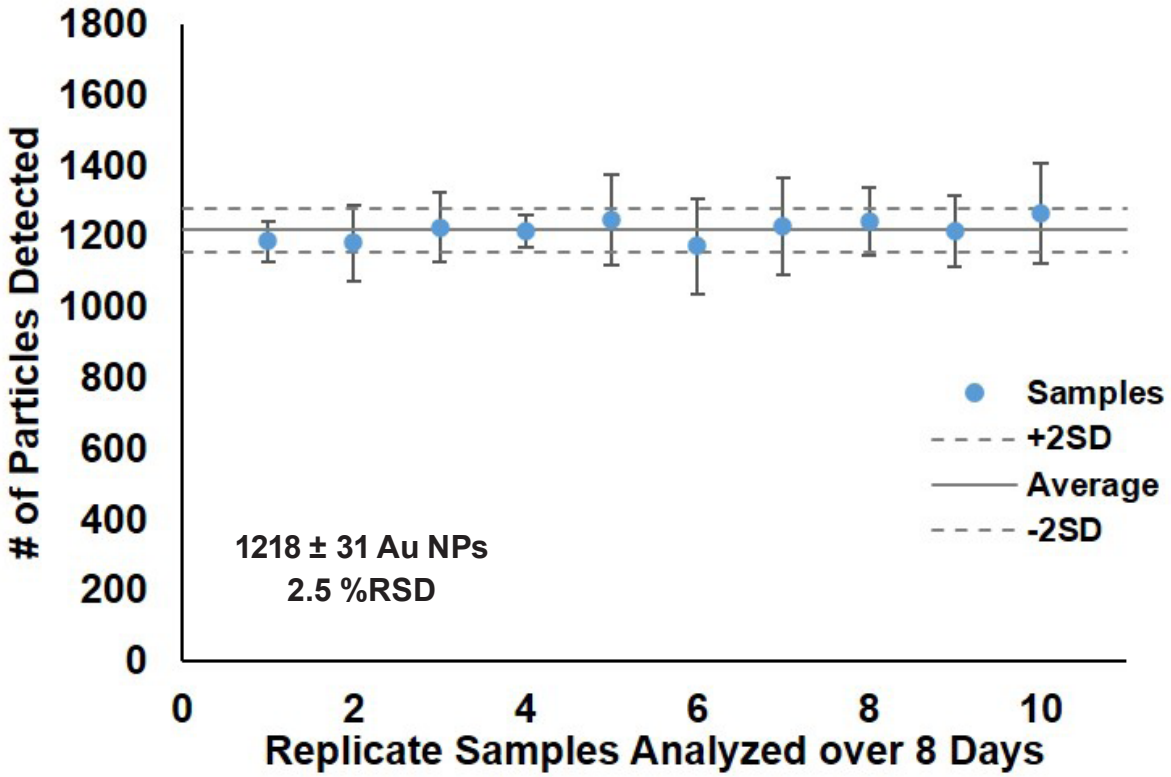


Backpressure was recorded for varying nebulizer gas flow rates using 10 and 50 µL/min sample flow (DI water as the carrier solution).

Nanoparticle Performance

50 nm Au NPs

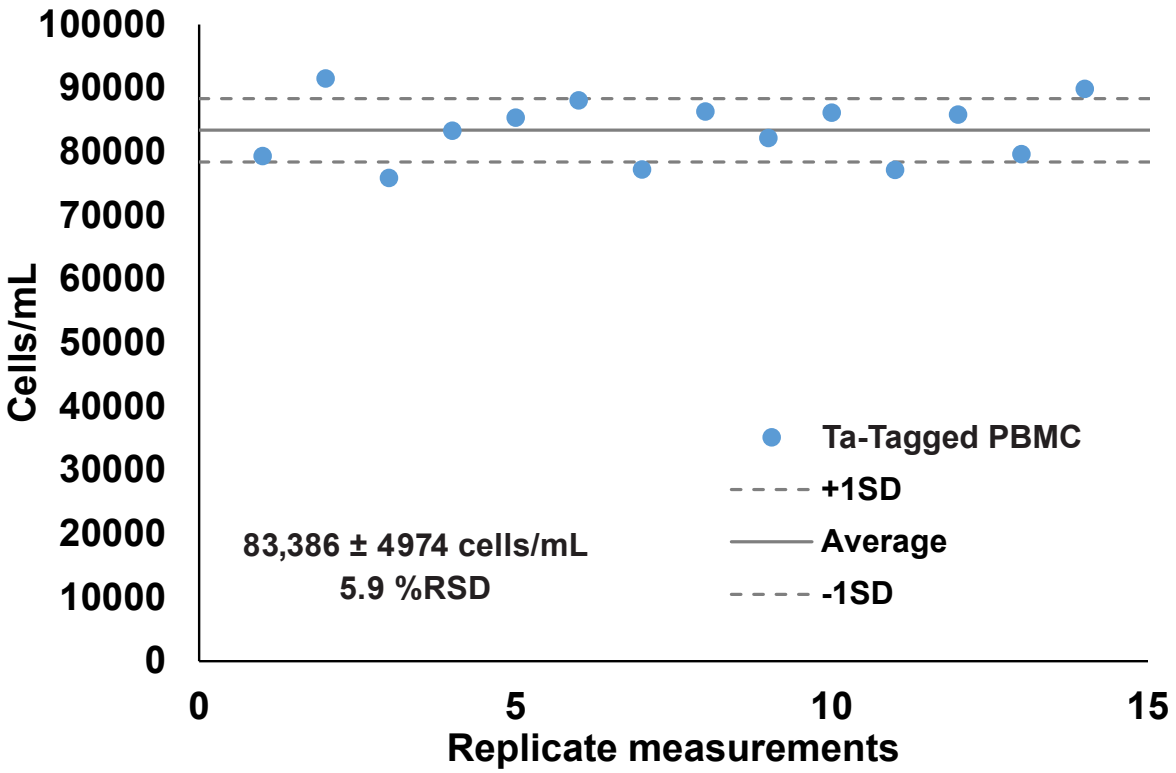
Typical Transport Efficiency for 50 nm Au NPs = ~90%



Ten 50 nm Au NPs were prepared under the same conditions and analyzed over an 8-day period. Samples were sonicated before each day's analysis. Data points represent the average response for each sample over the 8 days. Error bars represent ±1 standard deviation (SD) over the 8 days. The plot above shows the average response for all data points and the ±2 SD.

Single Cell Performance

Ta-Tagged PBMC



PBMC = peripheral blood mononuclear cell

Ta-Tagged cells were prepared in PBS buffer. The plot above demonstrates replicate measurements from a single sample. Cell transport efficiency will vary depending on cell type and cell stability.

microFAST Single Cell Features

Optional ULPA Filter or Air Shower

Exhausted Enclosure

- Three side easy access doors

AutoAlign Arm

- Self-realigns after encountering capped sample tube

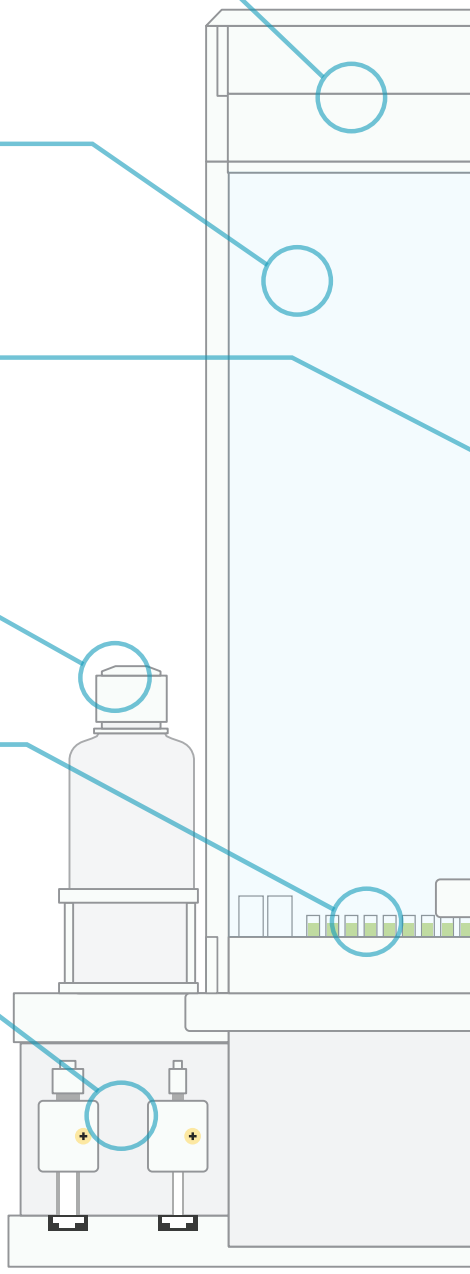
Carrier and Working Solution

Sample Containers

- 0.5 mL vials to 30 mL tubes
- Microplates

Syringes

- High precision syringes
- Stable flow rates at low flow rates (e.g. 10 µL/min)



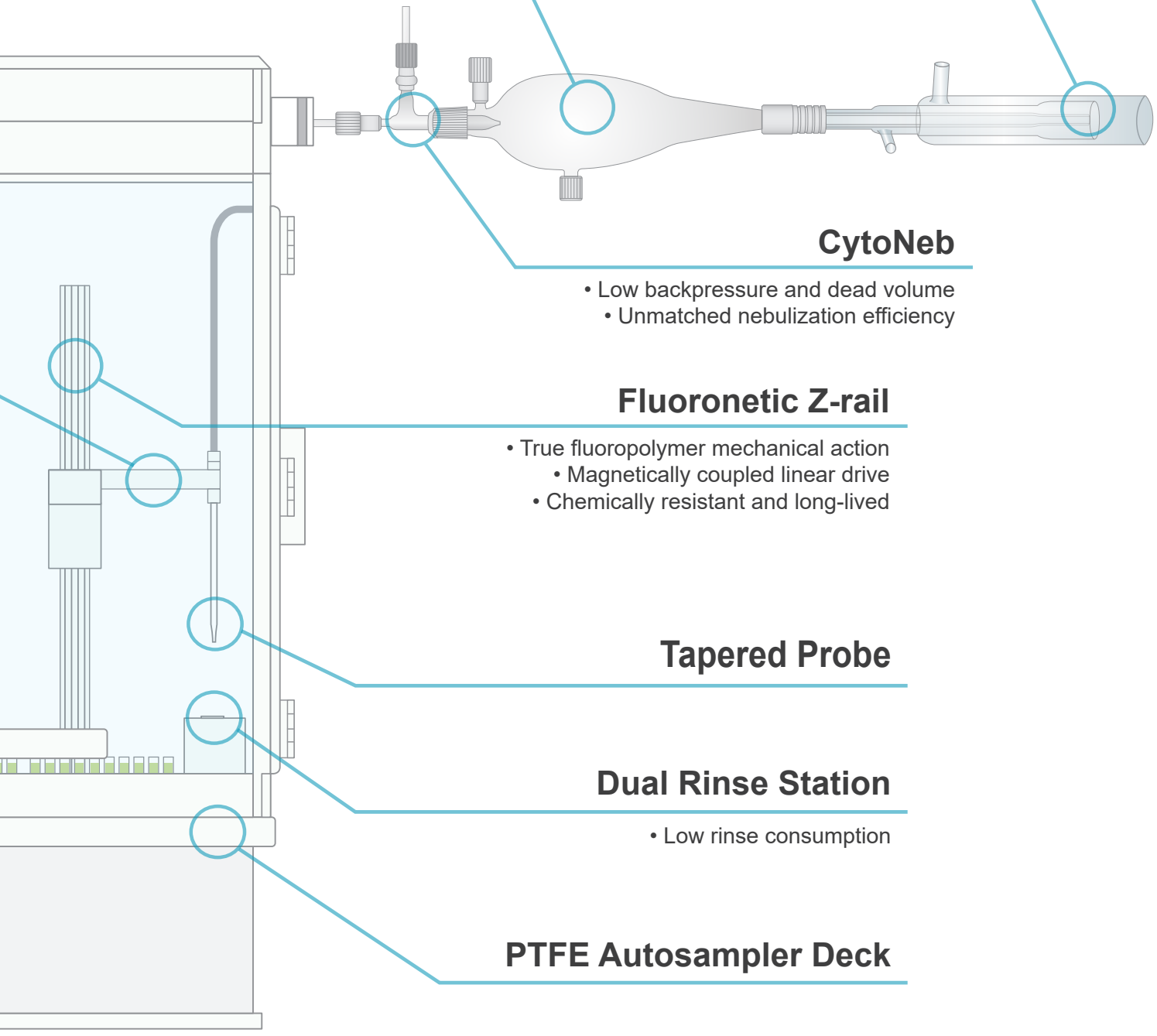
microFAST Single Cell Features

CytoSpray

- Specifically designed for single cell and nanoparticle applications
- Designed for high-transport efficiency

One-piece ICPMS Torch

- Simple and direct connection to CytoSpray



CytoNeb

- Low backpressure and dead volume
- Unmatched nebulization efficiency

Fluoronetic Z-rail

- True fluoropolymer mechanical action
- Magnetically coupled linear drive
- Chemically resistant and long-lived

Tapered Probe

Dual Rinse Station

- Low rinse consumption

PTFE Autosampler Deck

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