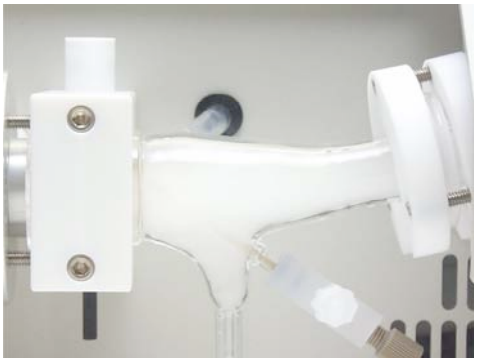
U5000AT+ Technical Note

Principle of Operation

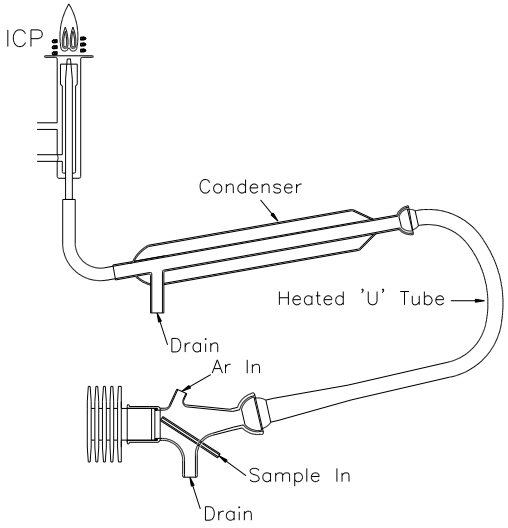
A peristaltic pump introduces liquid sample across an oscillating piezoelectric transducer. The oscillations disperse the sample into a fine aerosol, which is swept out of a spray chamber by a flow of argon gas from the host ICP-AES or ICP-MS instrument.



Nebulization of 1% HNO_3

The aerosol passes through a heated tube and an electrothermally cooled condenser. An integrated drain pump removes the condensed sample solvent and any excess sample liquid from the spray chamber.

After the condenser, the dried aerosol particles are swept by the nebulizer gas to the ICP instrument for analysis.



Schematic of U5000AT+

Detection Limits

Instrument detection limits (IDLs) with the U5000AT+ Ultrasonic Nebulizer are listed for radial and axial-viewing ICP-AES and quadrupole ICP-MS instruments. Normal instrument conditions (ICP power and gas flows) were used.

Conventional pneumatic nebulizers are generally only 2 to 3% efficient under normal operating conditions. The U5000AT+ converts more of the liquid sample into a usable aerosol, with an efficiency of 10 to 15%. The result is up to a 10 fold or greater reduction in IDLs using either ICP-AES or ICP-MS.

For ICP-AES, detection limits fall below 1 ppb for many elements, while for ICP-MS sub-ppt limits can be achieved. Note that even lower limits may be obtained under cleanroom conditions.

CETAC

ICP-AES Detection Limits
Radial-Viewing (µg/L)

Element	λ (nm)	Cross-flow	U5000AT+		Element	λ (nm)	Cross-flow	U5000AT+
Ag	328.06	2	0.3		Mo	202.03	8	0.3
Al	396.15	9	0.5		Ni	231.60	10	0.4
As	193.69	18	2		Pb	220.35	27	1
Be	313.04	0.3	0.02		Sb	206.83	12	3
Cd	214.43	2	0.2		Se	196.03	20	1
Co	228.61	5	0.3		Tl	190.80	22	5
Cr	267.71	4	0.2		V	292.40	2	0.2
Cu	324.75	2	0.3		Zn	213.85	2	0.2

3σ detection limit
10s integration time
Thermo Jarrell Ash ICAP 61

ICP-AES Detection Limits
Axial-Viewing (µg/L)

Element	λ (nm)	Concentric	U5000AT+		Element	λ (nm)	Concentric	U5000AT+
Ag	328.068	0.3	0.04		Li	670.784	0.06	0.002
Al	167.016	10	0.4		Mg	279.553	0.01	0.004
As	188.979	1.5	0.7		Mn	257.610	0.03	0.003
Au	267.595	1.0	0.2		Mo	202.030	0.5	0.09
Ba	455.403	0.03	0.002		Ni	231.604	0.3	0.06
Be	234.861	0.01	0.002		Pb	220.353	0.8	0.2
Bi	223.061	2	0.2		Sb	206.836	2	0.3
Cd	214.438	0.05	0.01		Se	196.026	2	0.5
Co	238.892	0.2	0.03		Ti	334.941	0.1	0.007
Cr	267.716	0.15	0.02		Tl	190.790	2	0.2
Cu	327.396	0.3	0.05		V	292.402	0.2	0.03
Fe	238.204	0.1	0.03		Zn	213.856	0.2	0.01

3σ detection limit
30 s integration time
Varian Vista Pro ICP-AES

ICP-MS Detection Limits
(ng/L)

Element	m/z	Cross-flow	U5000AT+		Element	m/z	Cross-flow	U5000AT+
Be	9	2	0.1		Mo	95	1	0.04
Mg	24	8	0.7		Ag	107	0.3	0.04
Al	27	9	1		Cd	111	0.7	0.06
V	51	10	0.2		Sb	121	0.8	0.2
Cr	53	50	1		Ce	140	0.1	0.02
Ni	6	4	0.5		Pt	195	0.4	0.2
Cu	63	2	0.4		Au	197	2	0.1
Zn	66	5	0.5		Pb	208	1	0.1
As	75	2	0.6		Th	232	0.06	0.002
Se	77	40	5		U	238	0.1	0.005

3σ detection limit
3.0 s integration time
PerkinElmer ELAN 9000 ICP-MS
Non-cleanroom conditions