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Environmental Application Note Reference Guide



Ensure a safer environment

Around the world, environmental threats continue to evolve, and compliance standards and regulations along with them. Our portfolio of environmental analysis technologies is designed to meet not just today's requirements, but tomorrow's as well, providing reliable, accurate and precise results that can make compliance simpler and help minimize regulatory risks.

The Environmental Application Note Reference Guide will be relevant to testing labs and municipal testing facilities in understanding the latest methods and regulatory requirements for the analysis of a broad range of analytes and contaminants in air, water, and soil using our latest chromatography, mass spectrometry (LC, GC, IC, and MS); TEA (ICP-OES, ICP-MS); and /elemental analyzers (OEA and IRMS) instrument technologies.

The Environmental Application Reference Guide is a repository of our recent App Notes organized according to 5 analyte categories;

- Anions, Cations, and Disinfection Byproducts
- Emerging Contaminants
- Organic Contaminants
- Metals
- Elemental Analysis



Anions, cations, & DBPs

Analyte	Thermo Scientific™ Product model	Column	Matrix	LOD	Regulatory method	Application notes
Common inorganic — F, Cl, Br, Nitrite, Nitrate, Sulfate, Phosphate	Aquion™	AS22	Drinking, Waste, and Bottled Water	ppm	EPA 300	Determination of inorganic anions in drinking water using a compact ion chromatography system
Common inorganic — F, Cl, SO ₄	Integrion™	AS18	Drinking Water	ppm	EPA 300	Determination of inorganic anions in environmental waters using a compact ion chromatography system
Common inorganic — F, Cl, Br, Nitrite, Nitrate, Sulfate, and Phosphate	Integrion, ISQ SQ MS	AS20	Drinking Water	ppb	EPA 300	Detection of common inorganic anions using a compact ion chromatography system coupled with a single quadrupole mass spectrometer
Bromide, bromate, chlorate, chlorite	ICS 5000™	AS9-SC 4 mm	Waste Water	ppm		Determination of nitrite and Nitrate in wastewater using capillary IC with UV detection
Inorganic anions and oxyhalides	ICS-6000™	AS30	Drinking Water	ppm		Improved resolution of inorganic anions and oxyhalides in the presence of ethylenediamine
Perchlorate	Integrion™	AS16	Drinking Water	ppm	EPA 314	Determination of perchlorate in drinking water using a compact ion chromatography system
Perchlorate	ICS 5000 IC	AS20, AS16	Drinking Water	ppm	EPA 314.2	Improved Determination of trace perchlorate in drinking water Using 2D-IC
Perchlorate	Integrion™, ISQ SQ MS	AS20	Drinking Water	ppb	EPA 332	Determination of perchlorate by U.S. EPA Method 332.0 using a compact ion chromatography system coupled with mass spectrometry
Perchlorate	Integrion™, MSQ Plus MS	AS20	Drinking Water	ppb	EPA 332	Determination of perchlorate by EPA Method 332.0 Using a compact ion chromatography system coupled with mass spectrometry (IC-MS)
Perchlorate	ICS-5000+ Hybrid™ HPIC, Fortis™, TSQ MS	AS20	Drinking Water	ppb	EPA 332	Tomorrow's quantitation: robust, reproducible quantitation workflows of perchlorate in water with IC-MS/MS
Fracking — NH ₄ , Ba, Li, K, Sr, Ca, Mg, Na, Acetate, Br, Cl, F, Formate, Nitrate, Sulfate	ICS-5000+	AS18, CS16	Fracking Flowback Water	ppm		Determination of anions and cations in produced water from hydraulic fracturing



Anions, cations, & DBPs

Analyte	Thermo Scientific™ Product model	Column	Matrix	LOD	Regulatory method	Application notes
Alkali and Alkaline Earth Cations, and Ammonium	Integrion™	CS16	Wastewater	ppm		Determination of inorganic cations and ammonium in environmental waters with a compact ion chromatography system
Inorganic Ions and Cr VI	Integrion™	AS7	Drinking Water	ppb	EPA 218.6	Sensitive determination of hexavalent chromium in drinking water using a compact ion chromatography system
Cr III and Cr VI	iCAP™ RQ ICP-MS	AG-7Toxin	Drinking Water	ppt	EPA SW-846 Method 6800	Determination of chromium species using ion chromatography coupled to inductively coupled plasma mass spectrometry
Chlorite, Bromate, Chlorate, and Bromide	Integrion™	AS19	Drinking Water	ppb	EPA 300	Determination of trace concentrations of oxyhalides and bromide in municipal and bottled waters using a compact ion chromatography system
Oxyhalides and Bromide	ICS 5000+ IC	AS27	Source, Mineral, Drinking Water	ppb	EPA 300	Improved determination of trace concentrations of oxyhalides and bromide in drinking water using a hydroxide-selective column
HAAs, Bromate, and Dalapon	ICS 5000+ IC, Fortis	AS24	Drinking Water	ppb	EPA 557	EPA Method 557: Analysis of haloacetic acids, dalapon, and bromate in drinking water by IC-MS/MS
HAAs, Dalapon, and Bromate	ICS 5000+ and TSQ Endura™	AS24	Drinking water	ppb	EPA 557	EPA Method 557: Analysis of haloacetic acids, dalapon, and bromate in drinking water by IC-MS/MS
8 Iodo DBPs	Q Exactive™ GC Hybrid Orbitrap™	TG-5MS	Water	ppb		Discovery of emerging disinfection by-products in water using GC coupled with Orbitrap MS
Cr III and Cr VI	Aquion™ IC, iCAP™ RQ ICP-MS		Drinking Water	ppt		Determination of chromium species using ion chromatography coupled to inductively coupled plasma mass spectrometry
Saccharides	ICS-5000	CarboPac™ MA1	Atmospheric aerosol	ppm		An HPAE-PAD method for determination of saccharides in atmospheric aerosol samples



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PPCPs	Ultimate™ 3000 LC, Exactive™ Plus Orbitrap MS	Betasil™ C18	Wastewater	ppb		Quantitative and semi-quantitative determination of PPCPs and their by-products in wastewater by Orbitrap MS
PFAS	TSQ™ Altis	Accucore™ RP-MS	Ground, Surface, and Wastewater	ppt	EPA 8327	Direct analysis of selected per- and polyfluorinated alkyl substances (PFAS) in ground, surface, and waste water by LC-MS/MS
PFAS	Ultimate™ 3000 RS UHPLC, Q Exactive™ MS; Orbitrap MS and MS/MS	Hypersil™ GOLD™ aQ	Drinking Water	ppt	537.1	A comparison between HRAM Orbitrap technology and MS/MS for the analysis of polyfluoroalkyl substances by EPA Method 537.1
PFAS	LC-Q Exactive™ Orbitrap MS	Hypersil™ C18, 5 µm	Drinking Water	ppt	EPA 537.1	Secondary validation study for EPA Method 537.1 using automated SPE followed by LC-Q Exactive Orbitrap MS
PFAS	AutoTrace™ 280, Vanquish™ Flex Duo UHPLC and TSQ Fortis™	Accucore™ RP-MS	Drinking water	ppt	EPA 537.1	Determination of PFAS in drinking water using automated solid-phase extraction and LC-MS/MS
Non Targeted Screening	EQuan MAX Plus™	Hypersil™ GOLD aQ	Surface, Ground, and Wastewater	ppt		Targeted and nontargeted MS analysis of contaminants in storm water retention ponds
Microcystins	Ultimate™ 3000	Acclaim™ PolarAdvantage II (PA2)	Drinking water	ppb		Sensitive determination of microcystins in drinking and environmental waters



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Organophosphorus	AutoTrace™ 280, TRACE 1310 GC	SPE (AutoTrace™ 280)	TG-1701 MS	Drinking and Surface Water	ppb		Determination of pesticide residues in drinking water using automated solid-phase extraction and gas chromatography with nitrogen phosphorus detection
16 target compounds	UltiMate™ 3000 LC	On-Line SPE	PA 2	Drinking Water	ppm	China GB/ T 5479-2006	Determination of pesticide residues and toxins in drinking water by online SPE – high-performance liquid chromatography
Phenols	TRACE™ 1310 GC, ISQ LT SQ MS	SPE (AutoTrace™ 280)	TG-5MS	Water	ppb	EPA 528	Determination of chlorophenols in water according to U.S. EPA Method 528
OCPs	TRACE™ 1310 GC		TG-5MS	Water, Soils	ppb	EPA 8081	Detection of organochlorine pesticides by GC-ECD following EPA Method 8081
OCPs	TSQ™ 9000 TSQ MS		TraceGOLD™ TG-5-SiMS	Surface Water	ppt		Automated sample preparation followed by sensitive analysis by GC-MS/MS for environmental contaminants in surface waters
Polar Pesticides	Integrion™ HPIC, TSQ Quantiva™ TQ MS		AS24A	Drinking Water, Surface Water, and Soil	ppt		Routine analysis of polar pesticides in water at low ng/L levels by ion chromatography coupled to triple quadrupole mass spectrometer
BTEX	TRACE™ 1310 GC	Head Space	TG-624	Water	ppb		Analysis of BTEX and chlorinated compounds in water via a dual detector configuration gas chromatograph
GROs (gasoline range organics)	TRACE™ 1310 GC	Head Space	TRACE™ TR-1	Water	ppm	EPA 8015D	Automated determination of gasoline range organics (GRO) in water via valve-and-loop headspace GC
91 target VOC compounds	ISQ™ 7000 SQ GC-MS	Purge and Trap	TraceGOLD™ TG-VMS 20m	Soil	ppb	EPA 8260 C	Helium conservation in volatile organic compound analysis using EPA Method 8260C
Polar, Non-Polar Halogenated Compounds	ISQ™ 7000 SQ GC-MS	Cannister, Water Removal, Pre- Concentration	TraceGOLD™ TG-VVOC B	Air	ppb		Completely cryogen-free monitoring of ozone precursors, air toxics, and VOCs in ambient air
GRO (gasoline range organics)	TRACE™ 1310 GC	Head Space	TraceGOLD™ TG-1MS	Water	ppb		Determination of gasoline range organics (GRO) in water by GC coupled with static headspace sampling
Alkylphenols	TRACE 1310 GC, TSQ Duo TQ MS		TG-5MS	Water	ppb		Analysis of alkylphenols using GC-MS/MS and automated SRM development



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Pesticides	ISQ™ 7000 SQ GC-MS		TraceGOLD™ TG-5MS	Soil, Air, Water	ppm	EPA 8270D	Optimized GC-MS solution for semivolatiles (SVOC) analysis in environmental samples in compliance with the EPA Method 8270D
HC>C ₁₂ HC:C _{10-C40}	ASE™ 350, FOCUS™ GC	ASE 350	Trace TR-5 GC	Soil and Rubble	ppm	UNI EN 1409:2005	Determination of total petroleum hydrocarbons in rubble and soils by accelerated solvent extraction and GC-FID
PAHs	TRACE™ 1310 GC, ISQ SQ MS	Solid Phase Micro Extraction (SPME)	TG-5 SiIMS	Tap Water	ppb		Determination of polycyclic aromatic hydrocarbons in drinking water at ppt levels by Solid Phase Micro Extraction Arrow coupled with GC-MS
Toxins	ISQ™ 7000 GC-MS SQ		TraceGOLD™ TG-5MS	Soil, Air, and Water	ppm	EPA 8270D	Optimized GC-MS solution for semivolatiles (SVOC) analysis in environmental samples in compliance with EPA Method 8270D
Nitrobenzene	TRACE™ 1310 GC	Ethyl Acetate & Dilution	TG-1701MS	Drinking Water	ppb	EPA 8091	Rapid determination of nitrobenzenes in drinking water using automated SPE with GC-ECD
Nitrosamines	TSQ™ 9000 TQ GC-MS/MS	SPE	TraceGOLD™ TG-1701 MS	Drinking Water	ppt	EPA 521	Unparalleled performance of Advanced Electron Ionization GC-MS/MS technology for the determination of nitrosamines in drinking water
Nitrosamines	TRACE™ 1310 GC, Exactive™ Orbitrap MS	SPE	TraceGOLD™ TG-1701MS	Drinking Water	ppb	EPA 521, EPA 522	Low level quantification of NDMA and non-targeted contaminants screening in drinking water using GC Orbitrap mass spectrometry
Nitrosamines	Ultimate™ 300 LC, Q Exactive Orbitrap MS		Hypersil™ GOLD C18	Drinking and Wastewater	ppb	EPA 521	Analysis of nine N-nitrosamines using liquid chromatography—high-resolution, accurate-mass mass spectrometry
PAHs	Vanquish™ Flex with ISQ EC (SQ) MS		Hypersil™ Green PAH	Water, soils	ppb		Detection of oxygenated PAHs (oxy-PAHs) in APCI mode with a single quadrupole mass spectrometer
Toxins	SolEx™ HRP cartridge, UltiMate™ 3000 LC	SPE	Acclaim™ 120 C18	Soil	ppb		Determination of aniline and nitroanilines in environmental and drinking waters by On-Line SPE



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PAHs	UltiMate™ 3000 LC	SPE	Acclaim™ 120 C18	Drinking Water	ppm		Rapid screening method for polycyclic aromatic hydrocarbons using an advanced solid core UHPLC column and system combination
Estrogen, Androgen, and Endocrine Disruptors	AutoTrace™ 280, Ultramate™ 3000	AutoTrace™ 280	Acclaim™ 120 C18	Drinking Water	ppm	EPA 539	Automated extraction and determination of human hormones in drinking water using solid-phase extraction and HPLC with UV detection
Endocrine Disruptors	EQuan MAX Plus™ and Q Exactive™ Focus Orbitrap™	SPE	Acclaim™ VANQUISH™ Polar Advantage	Drinking water, Fresh Water	ppt		Determination of ethinylestradiol using EQuan MAX and Q Exactive Focus Orbitrap LC/MS/MS system
Microplastics	TRACE™ 1310 GC, Exactive™ Orbitrap™ MS		TraceGOLD™ TG-5SiIMS	Soil	ppm		Pyrolysis-GC-Orbitrap MS — a powerful analytical tool for identification and quantification of microplastics in a biological matrix
Explosives	UltiMate™ 3000 LC	AutoTrace™ 280	Acclaim™ Explosives E2	Tap Water	ppm	EPA 8330	Automated solid phase extraction of 14 explosives in tap water based on U.S. EPA Method 8330 Using hydrophilic Reversed-Phase Cartridge Followed by HPLC-UV
Cyanotoxins	TSQ Quantis™	Acid Digestion	Accucore™ C18	Drinking Water	ppt	EPA 544	Quantitation of cyanotoxins in drinking water according to EPA 544 guidelines
Cyanotoxins	TSQ Quantis™	Filtration		Drinking Water	ppt	EPA 545	Reduced injection volume applied to the quantitation of cylindrospermopsin and anatoxin-a in drinking water according to EPA Method 545
Surfactants	AutoTrace™ 280, UltiMate™ 3000 LC	AutoTrace™ 280	Acclaim™ Surfactant Plus	Wastewater	ppm		Automated solid-phase extraction of linear alkylbenzene sulfonate in wastewater using a weak anion-exchange cartridge followed by HPLC with UV detection
PCBs	ASE™ 350, Rocket™ Evaporator, TSQ™ 8000 TQ GC-MS/MS, TRACE™ 1310 GC	ASE	TraceGOLD™ TG-17MS	Soil, Solid Waste	ppb	EPA 8082A, EPA 3540	Determination of polychlorinated biphenyls (PCBs) in soils and solid waste by accelerated solvent extraction and GC-MS/MS



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PCBEs	TRACE™ 1310 GC, Exactive™ Orbitrap MS	Soxhlet Extraction	TraceGOLD™ TG-PBDE	Air, Wastewater (sediment, sludge)	ppb		Overcoming analytical challenges for polybrominated diphenyl ethers (PBDEs) analysis in environmental samples using gas chromatography – Orbitrap mass spectrometry
SCCPs	Exactive™ GC Orbitrap MS		TraceGOLD™ TG5-SiIMS	Wastewater	ppb		A novel HRAM Orbitrap-MS based platform for routine analysis of short chain chlorinated paraffins
Polychlorinated Dioxins, Furans, PCBs, and PBDEs	DFS™ Magnetic Sector GC-HRMS			Water	ppm	EPA 1668, EPA 1614	High throughput analysis of polychlorinated dioxins/furans (PCDD/Fs)
Toxaphenes Congeners	DFS™ Magnetic Sector GC-HRMS			Water	ppm	EPA 1614	High sensitive MID detection method for toxaphenes by Magnetic Sector GC-HRMS
PCBs and PAHs	QuEChERS™ and TRACE™ 1310 GC		LinerGOLD™	Soil	ppb		Simultaneous routine GC-MS analysis of PCBs, PAHs, and their derivatives in soil using modified QuEChERS methodology



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Organotin	TRACE 1310 GC, iCAP RQ ICP-MS	Surface Water	ppb		Ultratrace tin speciation with GC-ICP-MS using the Thermo Scientific GCI 100 Interface
Arsenic	ICE™ 3000 Series AA Spectrometer	Rock, Soil, Water, and Air	ppb	EPA 200.9	Arsenic in natural waters by graphite furnace atomic absorption using EPA Method 200.9.
11 Metals and Elements	iCAP™ 7600 ICP-OES	Soil	ppb		Ultrafast agricultural soil analysis using the Thermo Scientific iCAP 7600 ICP-OES Radial
29 Metals and Elements	iCAP™ 7400 ICP-OES Duo	Drinking, Natural, and Wastewater	ppb	EU Directive (98/83/EC)	EU water analysis using the Thermo Scientific iCAP 7400 ICP-OES Duo
33 Metals and Elements	iCAP™ 7600 ICP-OES Duo	Drinking Water	ppb	EPA 200.7	US EPA Method 200.7 using the Thermo Scientific iCAP 7600 ICP-OES Duo
22 Metals and Elements	iCAP™ 7400 ICP-OES Duo	Groundwaters, Organic Waste, Soil, Sludge, and Sediment	ppb	EPA SW-846 Method 6010D	US EPA SW-846 Method 6010D using the Thermo Scientific iCAP 7400 ICP-OES Duo
48 Metals and Elements	iCAP™ RQ ICP-MS	Drinking and Wastewater	ppb	EPA 200.8	Fully automated, intelligent, high-throughput elemental analysis of drinking waters using SQ-ICP-MS
23 Metals and Elements	iCAP™ RQ ICP-MS	Sea Water	ppb		Analysis of high matrix samples using argon gas dilution with the Thermo Scientific iCAP RQ ICP-MS
8 Metals and Elements	iCAP™ RQ ICP-MS	Sea Water	ppb		Direct analysis of environmental samples using ICP-MS with argon gas dilution
22 Metals and Elements	iCAP™ RQ ICP-MS	Salt Water	ppb		Direct analysis of a 25% sodium chloride sample matrix using the iCAP RQ ICP-MS with argon dilution
23 Metals and Elements	iCAP™ RQ ICP-MS	Water, Soil	ppb	EPA SW-846 Method 6020B	EPA SW-846 Method 6020B using the iCAP RQ ICP-MS
Arsenic and Selenium	iCAP™ TQ ICP-MS	Soil	ppb		Accurate determination of arsenic and selenium in environmental samples using the Thermo Scientific iCAP TQ ICP-MS
5 Metals and Elements	iCAP™ TQ ICP-MS	Sea Water	ppt		Direct analysis of trace elements in estuarine waters using TQ ICP-MS
Cr III and Cr VI	Aquion IC, iCAP™ RQ ICP-MS	Drinking Water	ppt		Determination of chromium species using ion chromatography coupled to inductively coupled plasma mass spectrometry



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N, NC, CHNS/O and TOC	FlashSmart™ EA	Sewage Sludge	ppm		N, NC, CHNS/O and TOC characterization of sewage sludge by the FlashSmart Elemental Analyzer
CHNS/O	FlashSmart™ EA	Water and Air	ppm		CHNS/O characterization of particulate matter in water and air (filters)
NC	FlashSmart™ EA	Soils, Plants	ppm	EPA 440, UNI 13654-2, ISO 13878, ISO 10694, AOAC 993.13, Ital. Method 248	NC determination by single and double reactor at high weight sample by the FlashSmart EA
NC	FlashSmart™ EA	Soils, Plants	ppm		NC determination of soils and plants by combustion with a single reactor by the FlashSmart EA
CHN	FlashSmart™ EA	Soils, Plants	ppm		CHN characterization of soils and plants using argon as carrier gas
CHNS/O and TOC	FlashSmart™ EA	Sediments, Algae, and Plankton	ppm		CHNS/O characterization and heat values calculation of biomass and biofuels by FlashSmart EA
CHNS/O	FlashSmart™ EA	Biomass and Biofuels	ppm	EPA 200.8	Fully automated, intelligent, high-throughput elemental analysis of drinking waters using SQ-ICP-MS
CNHS	FlashSmart™ EA	Soils, sediments, sludges, particulates, fertilizers	ppm	AOAC 993.13, N (Total) in Fertilizers 2.4.02; ISO 2241-2; ISO 10694, UNE 77321; ISO 1378, UNE 77325; UNE EN 13654-2; EPA 440; Ital Method 146; Ital Method 248	Which official methods are fulfilled with the FlashSmart Elemental Analyzer
CHNS/O	DELTA V™ IRMS	Water and Air	ppm		How can stable isotopes be used to trace pollution sources and environmental change?
PM2.5 particles	EA-IRMS	Air	ppm		EA-IRMS: Using isotope fingerprints to track sources of PM2.5 in air pollution
PAHs	GC-IRMS	Soil and Sediment	ppm		GC-IRMS: Tracing pollutants in soil and sediment using carbon isotope fingerprint
δ13C, δ15N, and δ34S	EA-IRMS	Wood	ppm		Simultaneous δ13C, δ15N, and δ34S analysis of wood with the EA IsoLink IRMS system



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